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Volume 16, Number 20 October 31, 1962

NUCLEAR SCIENCE ABSTRACTS

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

26642 (BMI-1577(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING APRIL 1962. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). May 1, 1962. Contract W-7405-eng-92. 89p.

Research and development progress is reported on reactor materials and components, studies of fuels, general fuel element development, preparation of UO_2 single crystals, radioisotope and radiation applications, materials development and evaluation, coated-particle fuel materials, corrosion studies of the fluoride volatility process, development of cold bonding processes, creep-rupture of SAP alloys, and the Army gas-cooled reactor fuel program. (J.R.D.)

26643 (JLI-650-8-8) BASIC STUDIES IN RADIATION TECHNOLOGY. Final Report, November 2, 1959 to October 31, 1961. William H. Johnston (Johnston (William H.) Labs., Inc., Baltimore). Jan. 1962. Contract AT(11-1)-650. 225p.

A coincidence mass spectrometer was designed and constructed. Several measurements were completed of fragmentation patterns of excited molecule-ions of multiply-charged ions, and of the abundances of products of fast metastable decompositions. The quasi-equilibrium theory of unimolecular reactions was improved and extended. The moments of the pulse height distributions expected from an electron multiplier were calculated. Industrial progress toward economically feasible radiation chemical processing was analyzed. Several potentially feasible radiation chemistry processes were selected and studied. Suggestions concerning the mechanisms for these radiation chemical reactions are given. A survey was made on the status of radiation chemistry in Japan. (M.C.G.)

26644 (NP-11755) RESEARCH SUMMARY NO. 36-14 FOR THE PERIOD FEBRUARY 1, 1962 TO APRIL 1, 1962. (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). May 1, 1962. Contract NAS 7-100. 164p.

Progress is reported on the subjects of experimental space science, planetary studies, systems analysis, guidance and control research, flight computers and sequencers, communications systems research, communications elements research, chemistry research, gas dynamics research, materials research, plasma propulsion, liquid propellant propulsion, and polymer research. (J.R.D.)

26645 (NP-11911) SURVEY OF ACTIVITIES, 1961. (Norway. Institutt for Atomenergi, Kjeller and Norway. Institutt for Atomenergi, Halden). 24p.

A survey is presented of work carried out at the Institutt for Atomenergi (IFA) at Kjeller and in Halden during 1961. Topics covered include: JEEP, NDRA, JEEP II, chemistry, metallurgy, reactor dynamics, neutron physics, ship propulsion studies, isotope production and development, O.E.C.D. Halden reactor project, the Netherlands'–Norwegian Reactor School, safety and health physics, technical information service and international cooperation. (M.C.G.)

26646 (NYO-2668) PROGRESS REPORT NO. 59 [ON NUCLEAR RESEARCH]. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Nov. 1, 1961. Contracts AT(30-1)-2098; AT(30-1)-905; NASw-37; and NASw-75. 167p.

Research progress on nuclear chemistry and physics is reported. Topics covered include: chemistry of fission elements, nuclear chemistry (inorganic), nuclear chemistry (organic), cosmic rays, bubble chamber studies, linear accelerator studies, high energy accelerator physics, Rockefeller generator studies, radioactivity, cyclotron studies, and theoretical physics. (M.C.G.)

26647 (TID-3712) INFORMAL LISTING OF BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. Bibliographies Issued or in Progress During the Period, June–July 1962. (Division of Technical Information Extension, AEC). 29p.

A list of 157 bibliographies published, in preparation, or planned in nuclear energy is given. Separate subject, author, and report number indexes are given. (P.C.H.)

26648 THE CONSTRUCTION OF NUCLEAR POWER STATIONS IN UNDER-DEVELOPED COUNTRIES. Ulrich Hummel and Wolfgang B. Hanau. Atomwirtschaft, 7: 246-8 (May 1962). (In German)

Factors justifying the construction of nuclear power stations in under-developed countries are discussed. The advantages to be gained by the industrial nation in giving technical and financial aid for such construction is discussed with particular emphasis on the pertinency with respect to the German Republic. (J.S.R.)

26649 PERIODIC CLASSIFICATION AND THE PROUST LAW. Emile Rinck and Pierre Feschotte (Laboratoire de Chimie Appliquee, Paris). Bull. soc. chim. France, No. 4, 856-62(Apr. 1962). (In French)

Progress realized in the knowledge of the solid state has permitted the identification of numerous crystalline phases whose composition was not defined in the meaning of the Proust law. Its rigorous validity has nevertheless served as a beginning for atomic theory; it continues to be utilized in the measurement of atomic weights and remains valid for the vast region of organic chemistry. The investigation of the limits of the validity of the Proust law leads to some

peculiarities of the metallic state which are closely connected to the periodic classification of elements. A new arrangement of the periodic table, permitting for the first time the integration of the rare earths and giving to hydrogen a very special place, takes into consideration a distinction between true metals and earth metals. This distinction is imposed by the fact that the Proust law, valid for compounds between metalloids and earth metals, is not always followed when these same metalloids unite with true metals. Finally, this law loses all significance in alloys between true metals. The exceptions to this rule are explained by the specialization of chemical properties which is shown when one passes from short periods to long periods, hydrogen and the metals with short period being considered as undifferentiated elements. The usage of a point of view borrowed from embryology permits, thus, the chemical and even the physical properties of these elements to be better connected. (tr-auth)

26650 ATOMIC BOMBS. D. Francisco Pascual Martinez (Junta de Energia Nuclear, Madrid). Energia nuclear (Madrid), 5: 4-12(Oct.-Dec. 1961). (In Spanish)

A general idea of the basic principles of an atomic bomb is given with a consideration of three types of bombs: fission bombs, thermonuclear or fusion bombs, and high yield bombs. (J.S.R.)

26651 RADIUM α-ACTIVITY OF CIGARETTE AND PIPE-TOBACCO ASH. E. T. Pallister and J. H. Green (Univ. of New South Wales, Kensington, Australia). Nature, 195: 487-8(Aug. 4, 1962).

Ash from Australian-made cigarettes and pipe tobacco was analyzed for radium by Goldin's radiochemical method. The activities found ranged from 2.7 to 7.3 $\mu\mu$c/g ash and 0.5 to 0.6 $\mu\mu$c per cigarette. (D.L.C.)

26652 DUST MEASUREMENTS USING MEMBRANE FILTERS CONTAINING RADIOACTIVE NICKEL. G. Kubie and K. Spurny. Pracovní lékařstvi, 13: 274-7(Aug. 1961). (In Czech.)

An acetone solution of the red nickel salt of salicylaldehyde salicyl-hydrazone labelled with Ni^{63} was added to colloid solutions from which suitable membrane filters were prepared. The filters had an approximate activity of 0.05 $\mu c/cm^2$. They were used for retaining various types of industrial dusts and aerosols in laboratory experiments and in field work. The concentrations in the samples were estimated by measuring the attenuation by the trapped dust of the soft betas from Ni^{63}. The lower range of sensitivity of the method was 0.2 mg/cm^2 and the range of practical application 0.2 to 2.0 mg/cm^2. Recommendations are made on methods and apparatus for rapid and automatic determination of concentrations. (auth)

26653 PROSPECTS FOR NUCLEAR POWER IN THE PACIFIC NORTHWEST. Floyd D. Robbins. Trend Eng. Univ. Wash., 14. No. 2, 5-12; 24(Apr. 1962).

Fundamental principles involved in nuclear energy conversion and the integration of this type of power plant into the electrical power complex are discussed; theory and practice using the nuclear reactor as a heat source are reviewed. Present trends and expected development are considered. (L.N.N.)

26654 THE JOINT RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY DIGEST, PERIOD FROM 1 JANUARY TO 31 MARCH 1962. Vol. 2, No. 1. (United States—Euratom Joint Research and Development Program). 58p. (ACCESS-134). $5.00 per yr.(Euratom).

The digest contains a cumulative list of contracts entered into before Mar. 31, 1962, the scope of programs contracted for during the report period, and a summary of progress on reactor-associated research and development. (J.R.D.)

BIOLOGY AND MEDICINE

General and Miscellaneous

26655 (NP-11966) QUARTERLY PROGRESS REPORT NO. 44 [ON RADIOBIOLOGY]. (Chicago. Univ. Air Force Radiation Lab.). July 15, 1962. Contract AF41(657)-252. 130p.

Separate abstracts have been prepared for each section in the progress report. (P.C.H.)

26656 (NP-11966(p.1-26)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. I. HISTOPATHOLOGIC FINDINGS IN THE TISSUES OF MICE EXPOSED TO FRACTIONATED FAST NEUTRON IRRADIATION. D. Vesselinovitch, F. W. Fitch, J. Meskauskas, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Results of studies of the tissues of male LAF_1 mice exposed to fractionated fast neutron irradiation at total accumulated dosage levels of 19, 57, 170, and 510 rep and to continuous fast neutron irradiation at dose levels of 0.20 and 0.066 rep per hour to death are given. It was found that fast neutron irradiation is associated with an increased incidence of leukemia and other neoplasms, amyloidosis, atrophy of the testis, and cellular abnormalities in the liver. The incidence of amyloidosis not only increased in the fast neutron irradiated animals, but the period of onset was shortened. Some animals exposed to a total dose of 170 rep exhibited amyloidosis within 28 days after their first exposure. The spleen was the most frequently involved organ, but the liver, adrenal glands, kidneys, gastrointestinal tract, testis, lymph nodes, and lungs were also frequently involved. Atrophy of the seminiferous tubules, which occurred at all radiation levels, was found to be a direct radiation effect. However, injury to the seminiferous tubules was most severe in mice exposed continuously to fast neutrons. Pleomorphism of the hepatic cells and nuclei was also frequently found in the irradiated mice. The liver cells of the animals contained large pale or hyperchromic nuclei having dumbbell or other bizarre shapes and the nuclei were often pyknotic or vacuolated. Many of the histological changes observed in the animals exposed to chronic fast neutron irradiation were characteristic of senile changes. (P.C.H.)

26657 (NP-11966(p.27-35)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. II. STUDIES ON THE TOXICITY OF RARE EARTH COMPOUNDS AND THEIR INFLUENCE ON RADIATION LETHALITY. David W. Bruce and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Studies on the mortality of male and female rats given samarium nitrate by intravenous injection showed that there is a sex difference with respect to the toxicity of the compound. Approximate LD_{50} values of 3.0 and 20.0 mg/kg were obtained for female and male rats, respectively. Administration of a sucrose-saline solution ad libitum in place of water caused an apparent decrease in the toxicity of praseodymium nitrate to female rats and prevented the decrease in the endogenous respiration of liver slices found after intravenous administration of 2.0 mg/kg of the metal when given alone or in combination with 400 r whole-body x irradiation. The evidence presented indicates that the increased excretion caused by the sucrose-saline solution is not the reason for the apparent decrease in toxicity. (auth)

26658 (NP-11966(p.36-42)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. III. CURRENT STATUS OF CHRONIC LOW LEVEL FAST NEUTRON IRRADIATION PROGRAM. A. Sandberg and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Groups of CF_1 female mice containing over 300 animals were exposed to chronic fast neutron irradiation (10 hr per day to death) at dose rates of approximately 1.5 and 0.15 rep per day for a period of 65 weeks. Life span shortening and histopathological effects were studied. The median survival time of non-irradiated control CF_1 female mice was about 53 weeks whereas the ST_{50} of the irradiated groups was 41 weeks for the high dose rate group and 51 weeks for the low dose rate group. (P.C.H.)

26659 (NP-11966(p.43-54)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION-INDUCED CHANGES IN ENZYME ACTIVITIES IN CERTAIN RAT TISSUES. Bernard E. Hietbrink, Ann B. Raymund, and Betty A. Ryan (Chicago. Univ. Air Force Radiation Lab.).

Studies were conducted to determine the radioprotective activity of batyl alcohol, which stimulates hematopoiesis, in rats. Administration of 10, 50, or 100 mg/kg of batyl alcohol immediately after 400 r x irradiation provided a moderate reduction in the biological effect of radiation in the hematopoietic tissues but appeared to enhance the injurious effects in the intestine. Injection of 100 mg/kg batyl alcohol immediately before 400 r x irradiation provided 31, 14, and 18% reduction in the biological effect of radiation in the spleen, thymus glands, and intestine, respectively. Marked beneficial effects were also observed in the spleen when 10 mg/kg of batyl alcohol was given immediately after x irradiation to rats pretreated with MEA. Daily injections of 10 mg/kg batyl alcohol to animals exposed to 400 r caused a modest increase in the rate of reversal of the adenosine triphosphatase activity of the spleen, did not substantially affect the enzyme activity of the thymus glands, and inhibited the normal rate of recovery of the cholinesterase activity in the intestine. Cystamine provided substantial beneficial effects to the spleen, thymus, and intestines when given 10 min before 400 r. In general, chemical mixtures provided protection to the spleen and intestine similar to that provided by combinations given separately. (P.C.H.)

26660 (NP-11966(p.55-64)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II. INFLUENCE OF X-IRRADIATION ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF RATS. Bernard E. Hietbrink, Betty A. Ryan, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

The radiosensitivity of drug metabolizing enzymes in the livers of young male rats was determined. It was found that the development of the enzyme activity of the livers of rats exposed to 100 r x irradiation at 23 days of age was substantially inhibited. Experiments on the influence of partial body shielding indicated that the administration of 200 r x irradiation to the liver area only did not affect the normal rate of development of the microsome enzymes and that shielding the liver area while exposing the remainder of the body to 200 r substantially reduced the inhibitory effect of 200 r on the normal synthesis of enzymes in the liver.

Daily administration of 20 r gamma radiation caused a moderate inhibition in the rate of development of the drug metabolizing enzyme and daily exposures to 40 r gamma radiation inhibited the synthesis of the enzyme system to essentially the same degree as single doses of 200 or 400 r x irradiation. Daily injections of 2 mg/kg methyltestosterone to young male rats caused a substantial stimulation in the normal rate of development of the drug metabolizing enzyme activity of the liver. Testosterone propionate or methyltestosterone caused 7 and 15% decreases, respectively, in the duration of action of hexobarbital in 44-day old rats. It is concluded that enzyme assays represent a valid indication of the effect of androgens and x radiation on the development of the drug metabolizing enzymes in the liver of young male rats. (auth)

26661 (NP-11966(p.65-78)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III. THE INFLUENCE OF X-IRRADIATION ON THE GLUCOSE-6-PHOSPHATE DEHYDROGENASE AND 6-PHOSPHOGLUCONIC ACID DEHYDROGENASE ACTIVITY OF RAT TISSUES. Kenneth P. DuBois and Ann. B. Raymund (Chicago. Univ. Air Force Radiation Lab.).

A quantitative assay procedure for measuring the activity of glucose-6-phosphate dehydrogenase was developed using 2-p-iodophenyl 3-p-nitrophenyl-5-phenyltetrazolium chloride (INT) as the hydrogen acceptor. The glucose-6-phosphate dehydrogenase activity of normal rat tissues was measured and the following values obtained: liver, 46.5; spleen, 12.5; thymus, 7.1; kidney, 18.1; intestine, 16.1; and brain, 9.6. The activity is expressed in terms of micrograms of INT and reduced by 1 mg tissue/hr. Exposure of rats to 800 r x irradiation caused decreased in the dehydrogenase activity of liver, thymus, and intestine but the amount of decrease in enzyme activity did not exceed 40% in any case. The activity of spleen, brain, and kidney was not decreased by 800 r whole-body x irradiation. Measurements of the effect of 800 r whole-body x irradiation on the 6-phosphogluconic acid dehydrogenase activity of rat tissues indicated that the enzyme is decreased in liver and intestine and to a lesser extent in the brain. (P.C.H.)

26662 (NP-11966(p.79-94)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. I. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. Plzak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

The evaluation of 42 compounds, chemically related to compounds known to possess radioprotective activity, is presented. The compounds include alcohols, amines, amides, amino acids, quinolines, piperazines, carbomates, thiazoles, and benzothiazoles. None of the agents exhibited significant protective activity against a lethal dose of x irradiation in mice as evidenced by 30-day survivors. Several nitriles and a phenone, closely related to previously tested protective nitriles, were retested to see if difference in toxicity between samples might influence their protective activity. However, no protection was demonstrated. Twelve compounds suggested as possible intermediates in the production of methemoglobin in vivo were evaluated for their potential radioprotective activity. However, none of the mice pretreated with the agents survived the 30-day period following lethal whole-body x irradiation. Two porphyrins also failed to show marked protective effects. Two compounds, SC-19 and MEA, were found to have some protective effects on the mice. The 30-day LD_{50} for CF_1 male mice was found to be about 460 r. (P.C.H.)

26663 (NP-11966(p.95-122)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. II. STUDIES ON THE MECHANISMS OF THE TOXIC AND RADIOPROTECTIVE EFFECTS OF p-AMINOPROPIOPHENONE (PAPP) IN MICE. V. Plzak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Mechanisms of the toxic and radioprotective effects of p-amino-propiophenone (PAPP) were investigated in male and female CF_1 mice. Little change was found in the toxicity of PAPP when it was given by the intravenous rather than the intraperitoneal route to male or female mice. Following the administration of lethal doses of PAPP the mice became cyanotic within a few minutes but the first deaths did not occur for 2 to 3 hr if the mice were kept in a cool environment. None of the mice which survived for more than 2 days after the PAPP administration died during the subsequent 28-day observation period. Maximal radioprotective effects were obtained when PAPP was given at 4 to 8 min prior to x irradiation. Protective effects were evident, however, when PAPP was administered as late as one minute or as early as one hour prior to radiation, but there was no evidence of protective effects when it was given 2 hr before exposure. The radioprotective effect of PAPP can be almost eliminated by subjecting the mice to an increased environmental oxygen pressure (60 lb) during radiation exposure. The protective effect of PAPP is only slightly reduced when the PAPP treated animals are subjected to increased oxygen pressure prior to x irradiation in air at atmospheric pressure. (P.C.H.)

26664 (NP-11966(p.123-7)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. III. STUDIES ON THE DOSE REDUCTION FACTOR FOR IRRADIATION LETHALITY IN MICE AS A FUNCTION OF THE DOSE OF MERCAPTOETHYLAMINE. H. D. Landahl and A. T. Hasegawa (Chicago. Univ. Air Force Radiation Lab.).

The dose reduction factor, using 30-day mortality in mice as a criterion, was found to be approximately proportional to the dose of MEA up to a dose of 600 mg/kg when the drug is administered intraperitoneally. At this dose level the factor is about 2.7 under the experimental conditions used. The variability in mortality is approximately proportional to the radiation dose and independent of the doses of MEA. While much higher doses of MEA can be tolerated in the absence of irradiation, these doses must be administered more carefully if the animals are to be irradiated. When such care is taken, then a dose reduction factor greater than 3 can be obtained when the MEA is given intravenously. (auth)

26665 (NP-11966(p.128-30)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. IV. PROTECTION BY MERCAPTOCETHYLAMINE (MEA) AND PARA-AMINOPROPIOPHENONE (PAPP) AGAINST RADIATION INJURY TO THE GASTROINTESTINAL TRACT OF MICE. H. D. Landahl and A. T. Hasegawa (Chicago. Univ. Air Force Radiation Lab.).

The 30-day LD_{50} for female mice exposed to x-irradiation of the gastrointestinal tract only was calculated to be about 1240 r. Administration of MEA (400 mg/kg) prior to x irradiation resulted in a dose reduction factor of 1.6. Administration of PAPP (45 mg/kg) before x-irradiation of the gastrointestinal tract resulted in some protection and a dose reduction factor of 1.4. (auth)

26666 (JPRS-13555) SOVIET BIOCHEMISTRY STUDIES ON BLOOD AND METABOLISM. Translation of Voprosy Pitaniya, 21: No. 2, 37-9; 76-80(1962). 20p.

The results of tests show that the addition of malt extract to the diet of athletes is more effective in improving muscular work than the ingestion of glucose. The results, based on sugar content and lactic acid level in the blood, show that the malt extract increases the sugar content, which does not decrease even during the rest period, while the lactic acid level does not rise as much as when glucose is taken. (N.W.R.)

26667 (JPRS-13555(p.7-17)) THE EFFECT OF X-IRRADIATION ON THIAMINE (VITAMIN B_1) METABOLISM. M. M. Kubareva. Translated from Voprosy Pitaniya, 21: No. 2, 76-80(1962).

Whole-body irradiation of rabbits with large doses (800 r) decreases the amount of thiamine in the blood and urine, the minimum occurring two days after irradiation. Large amounts of thiamine (1.5 mg/kg) injected subcutaneously before and after irradiation neither prevented the rabbits from developing radiation sickness nor increased the survival rate despite the high content of the vitamin in the blood and urine. Oral administration of small doses (0.83 mg/kg) of thiamine before and after irradiation eased the course of radiation sickness, increased the survival rate, and promoted rapid weight gains. (N.W.R.)

26668 (JPRS-14767) PATHOLOGICAL PHYSIOLOGY AND EXPERIMENTAL THERAPY. Translation of Patologicheskaya Fiziologiya i Eksperimental'naya Terapiya, 6: No. 2, 18-35; 68-9; 76-82(Mar.-Apr. 1962). 78p.

Six articles are included; separate abstracts have been prepared for three. The articles not abstracted in NSA include information on the development of acidosis in a focus of normergic and hypergic inflammation, the significance of tissue thermometry during the infliction of burns under experimental conditions, and biochemistry of burn sickness. (P.C.H.)

26669 (JPRS-14767(p.1-13)) THE CONDITION OF THE CENTRAL AUTONOMIC REGULATION OF CARDIAC ACTIVITY IN IRRADIATED ANIMALS. N. P. Smirnova. Translated from Patol. Fiziol. i Eksptl'. Terap., 6: No. 2, 18-22(Mar.-Apr. 1962).

Studies were made on the effects of radiation on the heart in rabbits. The over-all action of x radiation in doses evoking acute radiation sickness led to damage of central influences upon heart activity, which was indicated by changes in the excitability of the corresponding centers of the hypothalamus and changes in the supra-liminal effects of its irritation. The thresholds of excitability of the hypothalamus change in the initial hours after irradiation. Characteristic features are their instability during the course of radiation sickness and lack of definition of the direction of change in individual animals. (P.C.H.)

26670 (JPRS-14767(p.14-21)) CHOLINESTERASE ACTIVITY OF THE BLOOD SERUM OF DOGS SUBJECTED TO GENERAL GAMMA-IRRADIATION. B. I. Davydov. Translated from Patol. Fiziol. i Eksptl'. Terap., 6: No. 2, 23-5(Mar.-Apr. 1962).

Twenty-four hours after general gamma irradiation of dogs at 400 r the activity of cholinesterase in the blood serum decreased 64 ± 6.3% in surviving dogs, and 29 ± 12% in dogs which died. In the surviving animals, hormone activity gradually was restored and attained the initial value 31 to 35 days after irradiation. Statistical verification of the decrease in cholinesterase content in the blood serum was observed 4, 11, and 14 months after irradiation, comprising 25 ± 5.3, 19 ± 3.4, and 16 ± 2.48%, respectively. (P.C.H.)

26671 (JPRS-14767(p.22-34)) THE DYNAMICS OF RESTORATION OF HEMOPOIESIS IN IRRADIATED MICE FOLLOWING BONE MARROW TRANSPLANTATION. I. I. Zaretskii (Zaretskiy), V. P. Reshchikov, M. P. Khokhlova, and N. M. Fertukova. Translated from Patol. Fiziol. i Eksptl'. Terap., 6: No. 2, 26-30(Mar.-Apr. 1962).

Bone marrow transplantations were made in irradiated non-pure and C_{57} strain mice. In the non-pure strain mice irradiated at 700 r, transplantation of homologous bone marrow enabled progressive restoration of blood formation to normal and increased the prolongation of life. Transplanted bone marrow cells mainly enter the hemopoietic organs of irradiated mice, where blood cells develop to mature forms. Transplantation of homologous bone marrow to C_{57} mice irradiated at 700 r did not produce a positive effect. (P.C.H.)

26672 ON THE APPLICATION OF A 185 Mev PROTON BEAM TO EXPERIMENTAL CANCER THERAPY AND NEUROSURGERY. A BIOPHYSICAL STUDY. Borje Larsson. Acta Univ. Upsal., No. 9, 23p.(1962).

Applications of a 185 Mev proton beam in experimental cancer therapy and neurosurgery are discussed. Both physical and biological aspects of the use of high-energy protons are considered. (C.H.)

26673 IDIOPATHIC PULMONARY HEMOSIDEROSIS. A Report of a Case from Japan. Paul A. Rudnick and Tsugiso Takamura (Atomic Bomb Casualty Commission, Hiroshima). Am. Rev. Respirat. Diseases, 84: No. 2, 256-62(Aug. 1961). (ABCC-TR-24-60)

A case of idiopathic pulmonary hemosiderosis in a Japanese child has been investigated and described. The diagnosis was confirmed by the demonstration of hemosiderin in phagocytes of the sputum and gastric juice. The clinical course, pathology, radiological findings, and concepts of pathogenesis are discussed. (auth)

26674 THERMAL TRANSITIONS IN NORMAL AND DEUTERATED RAT-TAIL TENDON, HUMAN SKIN, AND TUNA-FISH SKIN. B. J. Rigby (Commonwealth Scientific and Industrial Research Organization, Sydney). Biochim. et Biophys. Acta, 62: 183-5(July 30, 1962). (In English)

The transition temperature and shrinkage temperature of collogens were determined in normal and deuterated rat-tail tendon, human skin, and tuna-fish skin. Increases were observed in the deuterated samples. Results, obtained with solid collagen, are compared with those obtained with collagen in solution. It is concluded that hydrogen bonds are involved in both reactions. (C.H.)

26675 THE EFFECTS OF DEUTERIUM OXIDE ON BACTERIA. Rosalie Frances De Giovanni (Columbia Univ., New York). Dissertation Abstr., 22: 979(Oct. 1961).

The incorporation of deuterium into bacterial cells induced phenotypic and genotypic changes. Growth in D_2O media was inhibited; there was an increase in the lag period, an increase in the generation time, and a diminished final cell count. Several bacterial strains were studied and the degree of growth inhibition was strain-specific. No strain was inhibited below concentrations of 50% D_2O and no one strain grew as well as controls in media containing concentrations of 70% to 99.5% D_2O. The mixture of deuterium (in a high proportion) and hydrogen atoms probably gave rise to unsynchronized metabolic reactions in the cell that led to altered growth patterns. An overall isotope effect might have resulted from the differences between the reaction rates of the hydrogen and deuterium atoms. The addition of 0.5% NaCl (w/v) to D_2O media, decreased the inhibi-

tion of growth. No strain adapted to better growth in deuterium-containing media; however, a spontaneous deuterium-resistant mutant was obtained from one strain. Two strains formed enlarged, distorted cells when grown for more than eight generations in D_2O medium. Cells grown in D_2O medium, washed and resuspended in H_2O–0.85% NaCl (w/v) were up to sixty times more sensitive than controls, on a survival basis, to ultraviolet irradiation. For some strains, a high concentration of deuterium in the cell induced the occurrence of forward mutations. Many loci, but not all, showed an increase in the back-mutation rate over the spontaneous level, indicating some specificity of the mutagenic action of deuterium. The factor of increase over the spontaneous back-mutation rate ranged from 1.78 to 54.2. Deuterated bases were obtained from the highly polymerized DNA of a strain grown in D_2O medium. The nitrogenous bases containing the higher amounts of a deuterium were thymine and cytosine. None of the deuterated bases induced any phenotypic or genotypic effects when supplied to specific base-requiring strains. Apparently the effects induced by high concentrations of deuterium in the cell were not due solely to nitrogenous bases containing the isotope in stable positions. The total amount of deuterium incorporated into cells that had undergone four divisions in D_2O medium was one-half that of cells that had undergone eight divisions; the latter showed an increase in the back-mutation rate over the spontaneous level but the former did not. The amount of deuterium incorporation may be related to the mutagenic affect induced by deuterium. In addition, the mutagenic action of deuterium may be due to an interference of synthetic pathways concerned with DNA replication or to the distortion, by the mixture of hydrogen and deuterium bonding, of the DNA molecule. All these effects could induce errors at DNA replication time that could lead to mutant induction.

26676 EXPERIMENTAL DETERMINATION OF ABSORBED DOSE FROM X-RAYS NEAR THE INTERFACE OF SOFT TISSUE AND OTHER MATERIAL. Catharine Louise Wingate (Columbia Univ., New York). Dissertation Abstr., 22: 1218-19(Oct. 1961).

When cells of soft tissue adjacent to bone, such as osteocytes or marrow cells, are irradiated by x rays of less than 250 kv, the absorbed dose is substantially higher than that in soft tissue remote from bone for the same exposure dose. A similar effect occurs when tissue culture cells are irradiated on glass. Experimental measurements of the ratio of absorbed dose to exposure dose near a soft tissue-bone interface and a tissue-glass interface are made. The method employed involves measurement of ionization in a gaseous layer using a parallel-plate ionization chamber. One electrode of this chamber is made of muscle equivalent plastic, the other of bone equivalent plastic or glass. One electrode is movable so that the spacing can be varied. The use of either muscle equivalent gas or bone equivalent gas allows determination of the dose rate at very small distances away from the interface in either muscle or bone. The dose rate as a function of distance from the interface is obtained from the slope of the curve of ionization current vs. electrode spacing. Distribution curves of rad/r in the region of interest (less than 50 microns) about a bone-muscle interface are given for x-ray potentials of 30, 50, 140, and 210 kv. For the same four x-ray beams, curves of average rad/r in a soft tissue layer between two bone layers are given as a function of tissue thickness up to 25 microns. For the tissue-glass interface, curves of the relative increase in absorbed dose in muscle attributed to glass backing vs. tissue thickness are shown for x-ray tube potentials of 50, 140, 210, and 230 kv. Comparison of the experimental results with calculated values and biological studies of other workers are made where possible.

26677 RELATIONSHIP OF CERTAIN MACROSCOPIC MARINE ALGAE TO Zn^{65}. Paul Harry Bedrosian (Univ. of Florida, Gainesville). Dissertation Abstr., 22: 3146(Mar. 1962).

A study of the radioactive decontamination capacity of macroscopic algae was undertaken. Three algae, Gracilaria foliifera, Enteromorpha prolifera and Sphacelaria sp. were subjected to various controlled conditions of light and temperature in uptake experiments employing sea water dosed with Zn^{65}. Temperatures ranged from 5 to 25°C with light intensity varying from about 1 to 500 foot-candles. In separate investigations employing similar variations of light and temperature, non-radioactive growth rate determinations of Enteromorpha and Sphacelaria were made in order to associate the effect of such growth upon the uptake. To determine the retention capacity of algae, radioactive contaminated Sphacelaria samples were placed in two aquaria, one of which contained ordinary undosed sea water, while the other contained stable-zinc-enriched, undosed sea water. A translocation experiment and algal autoradiographs were used to aid in the general explanation of the uptake mechanism. The uptake experiments indicated that about 500 foot-candles of light and temperatures ranging between the approximate limits of 18 and 25°C were most conducive to maximum uptake. Of the factors contributing to the uptake, the more significant ones were perhaps the ratio of the algae's surface area to weight and the number of photosynthetic pigments in the algae. It was found that Sphacelaria in undosed sea water retained its Zn^{65} concentration approximately 0.7 day for the adsorbed portion and about 240 days for the absorbed portion — in undosed, zinc-saturated, sea water, the retentions were respectively 0.4 day and 240 days. Autoradiograph studies showed that Gracilaria's uptake was primarily one of absorption rather than adsorption. Enteromorpha's uptake was also primarily attributed to absorption. The autoradiographs indicated further that fast growing fruiting bodies concentrated Zn^{65} more rapidly than other parts of Gracilaria. No detectable translocation of Zn^{65} was noted with the equipment or method used. Approximate maximum concentration factors for the algae investigated ranged from 1,200 to 13,000. These factors were fairly independent of the concentration of Zn^{65} present in the sea water. Mascroscopic marine algae reduce the concentration of radioactive substances in sea water. Efficiency of this reduction is influenced by the number of accessory pigments contained by the algae and also by the organisms' surface-area-to-weight ratio. Some algae can be stimulated by chemical means to achieve their maximum concentration of Zn^{65} in a shorter time than normally required. By the same means they can be forced to release their concentrated Zn^{65} more quickly.

26678 LABELING OF HUMAN SERUM ALBUMIN WITH I^{131}. H. Herzmann and J. Klecker (Institut für Angewandte Isotopenforschung, Berlin). Isotopentechnik, 2: 157-8(May 1962). (In German)

A new method is given for the rapid and careful labeling of serum albumin with I^{131}. The method gives a calculated yield of about 80%. (tr-auth)

26679 POSSIBLE ERRORS ARISING FROM THE USE OF FRITTED-GLASS FILTERS FOR BUBBLING OF CELL SUSPENSIONS, ESPECIALLY IN IRRADIATION EXPERIMENTS. D. M. Ginsberg and J. Jagger (Univ. of Tennessee, Knoxville and Oak Ridge National Lab., Tenn.). J. Bacteriol., 83: No. 6, 1361-2(June 1962).

Large cell losses were found to result from the use of fritted-glass filters for bubbling cell suspensions during irradiation experiments with bacteria and phage. Such losses could cause serious errors in any experiments involving this technique. (C.H.)

26680 CONTRIBUTION TO THE DIAGNOSIS OF CEREBRAL TUMORS BY MEANS OF RADIOIODIZED ALBUMIN SERUM. M. F. Becchini, P. Fabiani, and R. Giordani (Università Pisa, Italy). Minerva nucleare, 6: 137-46 (May 1962). (In Italian)

Twenty-two cases of suspected cerebral neoplasm were studied by means of gamma-encephalography with human radioiodized serum albumin. Out of 15 cases of cerebral neoplasms 13 gave positive findings while in 7 cases the clinical symptomatology and laboratory examinations gave good grounds for suspecting neoplasm. The sight of the neoplasm was more easily determined from the findings of the gammaencephalographic examination than from those provided by angiography, at least when direct angiographic visualization is not possible. (auth)

26681 AUTOMATION OF PATTERN DISCRIMINATION IN THE RAT. John L. Falk and Constance J. D'Amato (New England Deaconess Hospital, Boston and Harvard Univ., Boston). Psychol. Repts., 1p.(1962).

Investigation of visual discriminative processes in animals has been facilitated by the use of automatic equipment and improved techniques of behavioral control. Visual generalization gradients and continuous changes in absolute threshold have been measured with new precision. As part of a program evaluating the pathological effects of prenatally administered ionizing radiation, the following schedule was used in determining the capacity for pattern vision. Animals were maintained at 70 to 80% of their free-feeding weight and trained to press either of two transparent plastic pigeon keys with their noses in order to obtain a 45-mg. food pellet. After one or two sessions of continuous reinforcement, the keys were transilluminated one at a time and circuitry was arranged so that 15 responses to an unlit key produced only the time-out condition. To avoid superstitious key responses during the time-out period, the occurrence of all such responses reset the 15-second time-out period. With daily sessions of 2-hr, the animals earned from 110 to 200 pellets and performed the brightness discrimination problem with few errors within one to two days. Then the keys were simultaneously transilluminated with patterns with the same reinforcement schedule in effect. The left-right position of the positive stimulus followed a pre-arranged random sequence. Fifteen responses to the negative pattern produced time-out and the same left-right arrangement was presented again on the following trial. The animal sets its own inter-trial interval by its work rate. Control sessions comprised the same schedule without the key stimuli being differential; a square pattern illuminated both keys. We have demonstrated pattern vision in normal rats and rats with cortexes characteristic of irradiation on the 13, 15, 17, or 19th fetal days, at or better than the 90% correct level in three to nine weeks. The occasional rat will not develop the discrimination under these conditions. We consider the arrangement workable but not ideal. (auth)

26682 THE DEUTERON MICROBEAM AS A TOOL IN BOTANICAL RESEARCH. H. H. Smith, H. J. Curtis, R. G. Woodley, and O. L. Stein (Brookhaven National Lab., Upton, N. Y. and Montana State Univ., Missoula). Radiation Botany, 1: 255-68(June 1962). (BNL-5899)

Maize kernels of a genetic stock heterozygous for Yg_2/yg_2 were irradiated at different dosages and positions with 22.5 Mev deuteron beams, 25 μ and 250 μ in width, from a 60-in. cyclotron. The most striking morphological effects in seedlings grown from irradiated embryos were chlorotic marks that appeared in the first four leaves. The location of the area irradiated, as evidence by the position of the radiation mark, was useful in determining radiosensitivity of different regions of the embryo and in comparing relative growth in different regions of the early leaves. The 25 μ, compared to the 250 μ beam, required about twice the radiation dosage to produce the same amount of evident damage based on clarity of radiation marks on the leaves and incapacitation of the stem apex. Radiation of the seed embryo enhanced elongation of the primary root for from two to four days after hydration. This effect was most pronounced when the microbeam passed through the leaves only and was least evident when the embryonic root itself was irradiated. Cytogenetic effects of microbeam radiation were detected by the appearance of yellow-green sectors in the leaves, owing to loss or mutation of the dominant Yg_2 allele. Maximum numbers of mutant sectors in seedling leaves were observed when the microbeam was directed toward the basal regions of leaves 1, 2, and 3 in the embryo. The size and position of mutant sectors can be used to study problems of cell lineage and histogenesis. (auth)

26683 RESPIRATION OF SOIL STERILIZED BY IONIZING RADIATIONS. George H. Peterson (Purdue Univ., Lafayette, Ind.). Soil Sci., 94: 71-4(Aug. 1962).

Electron- and x-ray-sterilized soil respires at a rate approaching that of nonsterile soil. Mercuric chloride decreases respiration of sterile soil, whereas incubating nonsterile soil with glucose for 48 hours prior to sterilizing with x rays increases subsequent respiration. Respiration of dead microbial cells may explain, in part, the poor correlation between plate counts and soil respiration. (auth)

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Refer also to abstract 27468.

26684 (TID-15972) A STUDY OF STRONTIUM, CALCIUM AND BARIUM RELATIONSHIPS IN SOILS AND VEGETATION. Progress Report. J. C. F. Tedrow (Rutgers Univ., Newark, N. J.). [1961]. Contract AT(30-1)-2494. 11p.

Three forested locations were characterized according to the principal vegetative species comprising the brush, understory, and climax canopy cover. Vegetation and soil samples were collected following a statistically designed pattern. Samples were analyzed spectroscopically for chemical composition. Data are tabulated on the concentrations of 20 elements in leaves collected during 1961. Results are compared with measurements made in 1960. Data from foliar and soil samples will be examined statistically for the relationships between Sr, Ca, and Ba. (C.H.)

26685 (TID-16380) EFFECT OF CHELATING AGENTS ON THE UPTAKE OF Y^{91}, Rh^{106}, Ce^{144}, AND Pm^{147} BY BEANS GROWN IN A CALCAREOUS SOIL. E. Essington, H. Nishita, and A. Wallace (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). July 1962. Contract AT(04-1)-Gen-12. 28p.

The influence of cyclohexane-1,2-diaminetetraacetic acid (CDTA), diethylenetriaminepentaacetic acid (DTPA),

and ethylenediamine di(o-hydroxyphenylacetic acid) (EDDHA) on the uptake of Y^{91}, Ru^{106}, Ce^{144}, and Pm^{147} by bean plants grown in a calcareous soil was studied. DTPA greatly increased the amount of Y^{91}, Ce^{144}, and Pm^{147} accumulated in plant parts, especially the leaves. CDTA increased the Y^{91} and Pm^{147} uptake but the uptake of Ce^{144} was affected only slightly. EDDHA slightly increased the Y^{91} and Pm^{147} accumulation in the leaves but did not affect that of Ce^{144}. In general, the three chelates did not significantly affect the uptake of Ru^{106} by plants. Application of chelating agents to the soil did not significantly change the dry weight yield of the plants. Paper chromatography of leaf extract indicated that Y^{91}-DTPA complex was present in the leaves of bean plants grown in a soil treated with Y^{91} and DTPA. This indicated that Y^{91}-DTPA complex may have been translocated from the roots to the leaves. (auth)

26686 (TID-16385) PHARMACOLOGY AND TOXICOLOGY OF TERBIUM, THULIUM, AND YTTERBIUM CHLORIDES. Thomas J. Haley, N. Komesu, A. M. Flesher, L. Mavis, J. Cawthorne, and H. C. Upham (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [Aug. 1962]. Contract AT(04-1)-Gen-12. 21p.

The pharmacology and toxicology of terbium, thulium, and ytterbium chlorides were investigated. Both acute intraperitoneal and oral toxicity of the three chemicals was of the delayed type. The symptoms of such toxicity have been described and were identical for all three chemicals. The chronic oral ingestion of these materials by rats at three dosage levels revealed that ytterbium did not affect the growth rate, whereas both terbium and thulium at the 0.1 and 1.0% levels suppressed growth of both sexes during the 12 week period. However, the hemograms of the animals were not affected. Perinuclear vacuolization in the liver was the only histopathological change found in all the tissues examined, and it appeared to be sex linked. The pharmacological responses to all three compounds were mainly depressant on all systems studied, and death was associated with cardiovascular collapse coupled with respiratory paralysis. The greatest damage observed was on abraded skin where ulcerations occurred that required 45 days for healing. Terbium also was very irritating to intact skin but did not produce scarring. This chemical produced transient damage to the cornea, and all three chemicals caused conjunctival ulcerations requiring 18 days for healing. The toxicological effects of terbium, thulium and ytterbium were compared with the other rare elements. (auth)

26687 (UCRL-10156) BIO-ORGANIC CHEMISTRY QUARTERLY REPORT, DECEMBER 1961 – FEBRUARY 1962. (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Apr. 3, 1962. Contract W-7405-Eng-48. 89p.

Progress is reported in investigations on the polymerization of formaldehyde, ultraviolet irradiation of aqueous $HC^{14}N$, radiation chemistry of nucleic acid constituents, oxidation of free sugars and aldonic acid derivatives by Acetobacter suboxydans, preparation and isolation of $C^{14}O_2$ ~ enzyme, metabolism of C^{14}-ribulose diphosphate by Nitrobacter agilis, $C^{14}O_2$ metabolism of Hordeum vulgare seedlings during the development of the photosynthetic apparatus, location and chemical characterization of RNA in the chloroplasts of Spinacea oleracea, inhibition of dark bleaching by stroma extracts and by inert gases, ESR studies on chromatophores from Rhodospirillium rubrum and on quantasomes from spinach chloroplasts, and phthalocyanine manganese and etioporphyrin manganese complexes. (J.R.D.)

26688 (AEC-tr-4642) BIO-CHEMICAL STUDIES OF Sr^{90}, Cs^{137} AND SIMILAR RADIONUCLIDES. Yoshio Hiyami. Translated from 1960 Annual Report No. 11, Tokyo University, Tokyo, Japan. 38p.

Quantitative bio-geochemical measurements were made of the movement and equilibrium relations of fall-out material (chiefly Sr^{90} and Cs^{137}). The movement consists of the food chain that starts with soil, water, land products, marine products, and food and ends with the human body. Data are presented on Sr^{90} content in Japanese rivers, Cs^{137} content in river water and soil and the movement to food, uptake of Sr^{89}, Ba^{140}, and Ca^{45} from soil by various farm products; contents of Sr^{90}, Ru^{106}, Cs^{137}, and Ce^{144} in tea leaves; Cs^{137} and Sr^{90} content in milk, Sr^{90} content in animals and fish included in man's diet, Sr^{90} content in standard diet and human bones; and the effect of Ca in the diet upon the retention of radioactive Sr. (P.C.H.)

26689 (FTD-TT-62-584) ELEMENTS OF RADIATION BIOCHEMISTRY. N. F. Lipkan. Translated from p.79-126 of "Elementy Radiatsionnoi Biokhimii" (a publication of State Publishing House of Medical Literature, Kiev, 1958). 58p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 20120.

26690 (JPRS-13919) BETATRON EQUIPMENT FOR MEDICAL PURPOSES. V. I. Gorbunov. Translated from Med. Prom. S.S.S.R., 16: No. 3, 55-7(1962). 8p.

A review is given of several Russian betatrons being used for medical purposes and accelerators which will be produced in the near future. Emphasis is placed on a 25-Mev betatron with a three-legged electromagnet, a rotary betatron with a hinged guard and a collimating device, and a 25-Mev betatron with a ten-post magnet. Specifications of the inductive accelerators are given. (N.W.R.)

26691 II. UPTAKE AND RETENTION OF STRONTIUM 90 IN STRONTIUM-90-INDUCED OSTEOSARCOMAS. A. Nilsson and S. Ullberg (Research Inst. of National Defense, Sundbyberg, Sweden and Royal Veterinary Coll., Stockholm). Acta Radiol., 58: 168-75(June 1962). (In English)

Osteosarcomas developed after 6 or 7 months in 200 CBA-strain male mice that received an injection of Sr^{90}. An autoradiographic study was made in order to investigate the distribution in tumors and unchanged bone-tissue of the radiostrontium that was injected. The sections used for autoradiography were also examined by microradiography. Bone-forming Sr^{90}-induced tumors were transplanted to other CBA mice and were found capable of growing in a radiostrontium-free environment. (auth)

26692 AUXILIARY DIAPHRAGM FOR RADIOISOTOPE TELETHERAPY UNITS. Rune Walstam (Röda Korsets Sjukhus, Stockholm). Acta Radiol., 58: 201-9(June 1962). (In English)

A simple auxiliary diaphragm for radioisotope teletherapy units is briefly described. The construction permits mounting of different accessories and can be used at any beam direction. Measurements are reported on electron contamination and penumbra reduction when adjustable beam-shaping blocks are introduced in the beam. (auth)

26693 PRECALCULATED DOSE DISTRIBUTIONS IN COBALT 60 FIXED FIELD AND ROTATION THERAPY. Paul M. Pfalzner (Ontario Cancer Foundation London Clinic and Univ. of Western Ontario, London, Ont.). Acta Radiol., 58: 215-25(June 1962). (In English)

The concept of precalculated multifield dose distributions was examined and justified for megavoltage teletherapy. The essential requirement in applying this method

is that equal tumor dose contributions (or a fixed predetermined ratio of such contributions) be delivered from each field rather than equal skin surface doses (or a fixed ratio of these). Examples are given of applying precalculated dose distributions for both the techniques of fixed source-to-skin distance and of fixed source-to-tumor distance, and some of the major advantages and limitations are pointed out. (auth)

26694 CALIBRATION AND STANDARDIZATION OF THYROID RADIOIODINE UPTAKE MEASUREMENTS. Acta Radiol., 58: 233-40(June 1962). (In English)

Recommendations are given for the calibration and standardization of I^{131} uptake by the thyroid gland. Comments are given to show the reasoning behind some of the points made. The recommendations are primarily for the 24 hr uptake determination, but significant factors to be observed when the uptake measurement is conducted earlier are also noted. The use of I^{132} for uptake measurements was also considered, but the recommendations set forth were drawn up primarily for work with I^{131}. (P.C.H.)

26695 INCORPORATION OF ^{18}O FROM AIR INTO HYDROXYPROLINE BY CHICK EMBRYO. D. Fujimoto and N. Tamiya (Tokyo Medical and Dental Univ.). Biochem. J., 84: 333-5(Aug. 1962).

The incorporation of atmospheric oxygen into the hydroxyl group of hydroxyproline by developing chick embryos was confirmed with O^{18} as a tracer. The hydroxyl group of tyrosine was not derived from air under these conditions. (auth)

26696 THE EFFECT OF ANOXIA AND LITHIUM IONS ON THE ABSORPTION OF D-GLUCOSE BY THE RAT JEJUNUM, IN VITRO. Robert G. Faust (Univ. of Oxford). Biochim. et Biophys. Acta, 60: 604-14(July 16, 1962). (In English)

A preparation in vitro of rat jejunum was used to measure glucose absorption, utilization and accumulation within the tissue under aerobic and anaerobic conditions, in the presence of Na^+ or Li^+. In some experiments the absorption of certain pentoses was measured in the presence of oxygen and Na^+ or Li^+. For short periods of incubation (5 to 7 min) the rate of glucose absorption from the mucosal fluid containing Na^+ was more rapid under anerobic than aerobic conditions. The slight increase in glucose utilization under these conditions could not account for this observed increase in absorption. When the period for sac incubation was extended to 10, 15, or 30 min, the rate of glucose absorption under anaerobic conditions was reduced to less than the rate of absorption under aerobic conditions. No glucose was accumulated within the tissue under anaerobic conditions at 50 mg of glucose per 100 ml of solution in the mucosal environment. Only a slight amount of glucose was accumulated, in comparison to the amount obtained in the presence of oxygen, when the glucose concentration in the mucosal fluid was increased to 100 or 200 mg of glucose per 100 ml of solution. If lithium ions were substituted for sodium ions in the 50 mg of glucose per 100 ml of solution bathing the mucosal surface, then the rates of glucose absorption, utilization, and accumulation were inhibited. The rates of glucose absorption in the presence of Li^+ were always more rapid under anaerobic than under aerobic conditions. The rates of absorption of the pentoses were uninhibited by the substitution of Li^+ for Na^+ in the mucosal fluid. The data presented in this investigation were considered in the light of a possible mechanism for sugar absorption by the small intestine. (auth)

26697 THE PREPARATION AND CHARACTERISTICS OF HIGHLY PURIFIED RADIOACTIVELY LABELLED POXVIRUS. W. K. Joklik (Australian National Univ., Canberra). Biochim. et Biophys. Acta, 61: 290-301 (Aug. 20, 1962). (In English)

Rabbitpox virus was grown in HeLa cells in medium containing P^{32} or L-[I-C^{14}] leucine. The virus was purified extensively and isolated as a discrete band in sucrose density gradients. Evidence is presented concerning the purity of such virus preparations. The P^{32}-containing virus was labelled principally in DNA (70% of the total radioactivity) and phospholipid (25%). In addition some label was liberated as inorganic phosphate following treatment with alkali. Evidence is presented which indicates that no RNA is present in the virus. The virus contains small amounts of inorganic phosphate and adsorbed RNA, DNA, and phospholipid which can be removed without lowering infectivity. Two examples are given illustrating problems which are greatly facilitated by the use of labelled virus. In the first it is shown that during the conversion of infectious to reactivable virus small amounts of protein are lost from the viral particles without exposure of DNA. In the second the effect of treatment with alkaline buffers (pH 11.4-12.0) was studied. The DNA of the virus becomes accessible to DNAase and in part diffuses out of the viral particle while only very little of the protein is solubilized. The significance of the observations is discussed. (auth)

26698 RARE-EARTH FATTY LIVER. I. OCTANOATE OXIDATION AND ENERGY PRODUCTION. Joseph L. Glenn, K. Tischer, and A. Stein (Albany Medical Coll. of Union Univ., N. Y.). Biochim. et Biophys. Acta, 62: 35-40(July 30, 1962). (In English)

The effects of cerium administration on octanoate oxidation, oxidative phosphorylation, and mitochondrial ATPase in liver were studied. Complete inhibition of the fatty acid oxidase system and marked uncoupling of phosphorylation are shown 48 h after the administration of this rare earth. These defects are not as pronounced at 24 h. The addition of known co-factors that function in fatty acid oxidation failed to restore octanoate oxidation. Extensive mitochondrial damage, evidenced by the loss of oxidative phosphorylation and marked ATPase activity, could explain the inability of these livers to oxidize octanoic acid. (auth)

26699 SEVERAL EXPERIMENTS UTILIZING RADIOISOTOPES. Yong-gyu Yi. Chosŏn Kwahakwon T'ongbo, No. 2, 21-2(Apr. 1959).

Test results are given for the phosphorus isotope metabolism balance and irradiation effects on seeds. A phosphorus-base fertilizer proved to be effective for corn, soybeans, and wheat. The proper time for applying phosphorus fertilizer to young plants is when the plants start to develop. The absorption of phosphorus is more active in the young cell of the plant than the old cell. In the soybean plant, the phosphorus observed in the day time returned to the soil during the night. Properly γ-irradiated corn increased its production by 10%. Similar results were obtained with γ-irradiated turnip seeds, and turnip seeds washed in an isotope solution. (OID)

26700 THE EFFECT OF BORON ON THE RATE OF INCORPORATION OF P^{32} BY THE NUCLEIC ACIDS OF THE SUNFLOWER. M. Ya. Shkol'nik and A. V. Kositsyn (V. L. Komarov Botanical Inst., USSR). Doklady Akad. Nauk S.S.S.R., 144: 662-4(May 21, 1962). (In Russian)

Six sunflower plants were grown from seed in a vessel 1.8 liters in volume on a Knop solution with and without boron. In 9 to 14 days the plants were transferred to a Knop solution of the same composition, containing phosphate tagged with P^{32} (10 to 40 μc of P^{32} tracer per vessel). Analyses of RNA and DNA were then made in 2 to

4 days on the roots, stems, cotyledons and upper leaves of the plants. The specific activities of the P^{32} in the nucleic acid fractions were determined. The analyses show that a boron defeciency slows down the synthesis of nucleic acids, especially in the parts of the plant where the growth of new tissue is intensive. The specific activity of the P^{32} in the nucleic acid fractions is about a factor of 10 higher when boron is fed to the plant. The results show that boron plays an important role in the synthesis of the nucleic acids. (TTT)

26701 ON THE TOXICITY OF BERYLLIUM OXIDE. V. V. Melnikov, A. E. Ivanov, and V. M. Ezhova. Gigiena i Sanit., 27: No. 4, 30-6(1962).

Introduction of beryllium oxide in the form of a finely dispersed aerosol into the respiratory tract of experimental animals (rats), at a concentration of 0.02 and 0.002 mg/l of air, produced a toxic effect. The clinical picture of poisoning in animals was characterized by a period of agitation, lasting 15 to 20 minutes, then followed by that of depression. As the intoxication progressed a permanent dyspnoea developed (140 to 150 respiratory movements per minute at rest). As the results of repeated action of beryllium oxide, round cell infiltrations and subsequent diffused sclerosis were found to develop in rats' lungs. Some animals revealed neoplasms of internal organs and skeleton at all the stages of observation. These lesions may also be connected with intoxication. (Public Health Eng. Abstr., 42: No. 7, July 1962)

26702 RELATIONSHIP OF AGE TO THE THYROIDAL ACCUMULATION, RENAL EXCRETION AND DISTRIBUTION OF RADIOIODIDE IN EUTHYROID MAN. George W. Gaffney, Robert I. Gregerman, and Nathan W. Shock (Dept. of Health, Education and Welfare, Bethesda, Md. and Baltimore City Hospitals). J. Clin. Endocrinol. and Metabolism, 22: 784-94(Aug. 1962).

Thyroidal accumulation, renal excretion, and blood levels of radioiodide after intravenous administration were measured in 131 middle-aged and elderly euthyroid, reasonably healthy men, 41 to 94 years of age. Thyroidal plasma radioiodide clearance and thyroidal radioiodide accumulation at 2 and 6 hours show statistically significant decreases with advancing age. Over the relatively narrow age span, 50–89 years, thyroidal radioiodide accumulation measured at 24 hours shows no change. A marked and statistically significant decrease with age in renal clearance of radioiodide is apparent. The radioiodide space does not change, but the plasma level at 6 hours increases with age. The latter finding is attributed to the decrease in renal clearance with age. Comparison of these results with those of others suggests that there exists an age-dependent decrease in thyroidal accumulation of radioiodide and in plasma radioiodide clearance. Within the interpretive limitations of the techniques, the changes reported are consistent with the view that thyroid hormone production decreases with advancing age. (auth)

26703 INFLUENCE OF ACTH ON THE ACCUMULATION OF RADIOIODINE IN THE HUMAN THYROID—A NEW EXTRA-ADRENOCORTICAL EFFECT OF ACTH. Gustaf Notter (Karolinska Sjukhuset, Stockholm). J. Clin. Endocrinol. and Metabolism, 22: 817-23(Aug. 1962).

The time-response relationship between a single intravenous injection of adrenocorticotropic hormone (ACTH) and thyroid-stimulating hormone (TSH), and their effect on the initial accumulation of radioiodine in the thyroid, was studied in normal, adrenalectomized, and adrenalectomized-hypophysectomized patients. The radioiodine uptake increased significantly in adrenalectomized patients 0.5, 1, 2 and 6 hours after intravenous injection of 25 IU ACTH (Acton, Ferring) and then returned to the initial level. Almost identical results were obtained from experiments using highly purified ACTH preparations from different laboratories. On the other hand, hypophysectomized, adrenalectomized-hypophysectomized and patients with normal endocrine function showed no increase in the uptake of radioiodine. Daily intramuscular injections of 25 IU ACTH (Acton prolongatum, Ferring) also produced a slight increase of the radioiodine accumulation during the period of observation (6 days). The effect of ACTH on the uptake of radioiodine in the thyroid was compared with that of TSH in the same group of patients. Following intravenous injection of 0.1 USP units TSH per kg body weight, the uptake increased slowly, was significantly higher after 3 hours, and reached its maximum after 24 to 36 hours. The difference between the effects of ACTH and TSH was significant. The increase of the uptake after ACTH was slighter, appeared sooner and disappeared more quickly, suggesting that it was a true ACTH effect and not one caused by contamination with TSH. (auth)

26704 ATTEMPT AT UNIQUE CLASSIFICATION OF RADIOELEMENTS ACCORDING TO THEIR RADIOTOXICITY. G. Vacca, A. Garnier, and H. Jammet (Commissariat a l'Energie Atomique, Paris). J. Radiol., Electrol. Med. Nucl., 43: 303-4(May 1962). (In French)

The unique classification offered by the authors is very similar to the one elaborated by the experts of A. I. E. A. who have, however, based their works on other considerations. Effectively, among the 236 radio-isotopes submitted to study, the differences concern only 5 of them which interest is, on the other hand, secondary: In^{115m}, Dy^{165}, Pt^{197m}, Pb^{203}, and Ra^{224}. The here-mentioned classification has the advantage of retaining the doses delivered to the various organs by taking into account the irradiation distribution in the course of time. (auth)

26705 ACCUMULATION OF RADIOACTIVE ISOTOPES OF STRONTIUM, RUTHENIUM, CESIUM, AND CERIUM BY SOME BACTERIA. T. V. Zharova (Academy of Sciences, Moscow). Mikrobiologiya, 30: 713-16(Mar.-Apr. 1962).

Results show that various radioactive elements are accumulated by bacteria in varying amounts. The value of the accumulation coefficients depends on the physical-chemical properties of the element, on the characteristics of the medium on which the bacteria are cultivated, and also probably on the physiological characteristics of the bacteria. Both in liquid medium and in the solid substrate, the bacteria maintain a definite selective relationship to the different radioactive isotopes. The accumulation coefficients of radioactive elements in bacteria in liquid medium considerably exceed those in solid media. Having the ability to accumulate radioactive isotopes in significant quantities, the bacteria can represent a danger in the transfer of radioactivity to the nutritive cycle, in which they are the first link. (Public Health Eng. Abstr., 42: No. 8, Aug. 1962)

26706 DISTRIBUTION OF ZINC-65 IN THE WASP, HABROBRACON, AND ITS EFFECTS ON REPRODUCTION. Daniel S. Grosch (North Carolina State Coll., Raleigh). Nature, 195: 356-8(July 28, 1962).

Adults of the habrobracon wasp were fed with Zn^{65} sulfate or exposed externally to Zn^{65} chloride. The radioactivity of whole wasps, body parts, and eggs were measured along with the hatchability of the eggs. Eggs were most radioactive on the third day and egg production was consistently lower than for control wasps. Nearly all the radioactivity in the wasp was abdominal; during the first two days, most of the ingested Zn^{65} was associated with

the digestive tract. In the male, the reproductive system did not become appreciably radioactive. Since less than 20% of the Zn^{65} meal is eliminated via the eggs, it is concluded that the effects of Zn^{65} are due to zinc toxicity. (D.L.C.)

26707 DIFFERENTIAL AUTORADIOGRAPHY OF TRITIUM AND ANOTHER β-EMITTER BY A DOUBLE STRIPPING FILM TECHNIQUE. K. B. Dawson (Royal Cancer Hospital, London), E. O. Field, and G. W. W. Stevens. Nature, 195: 510-11(Aug. 4, 1962).

An autoradiographic technique for studying the incorporation of two metabolites or the same metabolite at different times by a group of cells, was demonstrated with HeLa cells exposed first to tritiated thymidine and then to C^{14}-labeled thymidine. The specific activities were adjusted so that the exposure required for autoradiography of the tritiated compound was $\sim 1/10$ of that required for C^{14}. After fixing and staining, the cells were coated with autoradiographic emulsions by the stripping-film technique, the emulsion being without a gelatin supporting layer and thick enough to prevent penetration of tritium β particles. After a 1-day exposure to record the tritium, the emulsion was processed to give blue dye-coupled grains. The first autoradiograph was next coated with a second stripping emulsion and processed after 10 days' exposure to give black grains for C^{14}. The two images could be separated in the microscope by differential focusing. (D.L.C.)

26708 A NEW CLASS OF MEDICAMENT: RADIOACTIVE ISOTOPES. Yves Cohen (Centre d'Études Nucléaires, Saclay, France). Prods. pharm., 17: 1-16 (Jan. 1962). (CEA-2150). (In French)

Many radioelements are used medicinally, either for diagnosis or as therapeutics. The development of medicine has caused an increase in the number of applications of radioactive isotopes. After first being used in the form of simple inorganic molecules for diagnosis or as anticancer therapeutics, radioelements are now introduced into organic molecules used for specific function studies of all types. Their production is made difficult by their radioactive properties. Their pharmaceutical properties determined by tests and controls, are linked both to radiochemistry and to medicine. Methods of preparation and analysis, and medical applications are reviewed. (auth)

26709 TISSUE DISTRIBUTION OF MONOMERIC AND POLYMERIC PLUTONIUM AS MODIFIED BY A CHELATING AGENT. J. Schubert, J. F. Fried, M. W. Rosenthal, and A. Lindenbaum (Argonne National Lab., Ill.). Radiation Research, 15: 220-6(1961). (UAC-4657)

Mice injected with a polymeric (colloidal) solution of plutonium retained more of the radioelement in the liver and spleen and less in the bone than did mice injected with a monomeric plutonium solution. After daily diethylenetriaminepentaacetic acid therapy was initiated three days later, the bone levels of the radioelement were reduced about one-half in each case. The liver burden of mice injected with the monomeric form of plutonium was nearly completely removed after a few days of treatment, but that of mice injected with the polymeric form was reduced slowly and by only about one-third. In the case of the monomeric form of plutonium all the fecal plutonium was derived from the liver in both control and treated mice, while the urine contained plutonium from the other soft tissues and also from the bone of the treated animals. (auth)

26710 THE TURNOVER OF STRONTIUM-85 IN MAN AS DETERMINED BY WHOLE-BODY COUNTING. Stanton H. Cohn, Herta Spencer, Joseph Samachson, and James S. Robertson (Brookhaven National Lab., Upton, N. Y.). Radiation Research, 17: 173-85(Aug. 1962). (BNL 5805)

The retention of intravenously administered tracer doses of Sr^{85} was measured in ten patients directly by in vivo whole-body counting, and indirectly by the analysis of the urinary and fecal Sr^{85} excretions. Sr^{85} retention determined by the two methods differed during the first few days after administration of the isotope, inasmuch as the changing pattern of tissue distribution of the Sr^{85} altered the geometry and thus the counting efficiency of the NaI crystal detector of the whole-body counter. Retention in long-term studies can be expressed either as a series of exponentials or as a single-termed power function. The mean biological half-life of Sr for six comparison patients, based on the turnover of the slowest exponential component, was 843 days, as determined during the period 100 to 320 days. The mean value for radiostrontium retention, R, as a function of time for these six patients in the period 30 to 397 days after intravenous injection of the Sr^{85} was given by the power $R = 52.2t^{-0.175}$. Although both the exponential and the power function represent satisfactorily the experimental data obtained during the first year, the long-term projections of these functions diverge widely. As the final exponential term from which the half-life value is derived has been shown to depend on the period of time over which it is determined, it is preferable to use the power model to estimate retention over long periods. If the data are fitted with a power function and projected to 40 years, the half-life of the equivalent exponential term fitted to the period 20 to 40 years is 110 years in this study. More long-term data on the retention of isotopes are essential in order to provide a basis for choosing between the two mathematical models used to describe the biological turnover of Sr over a human life span. Use of the whole-body counter appears to be an excellent method for obtaining data on the retention of alkaline earths. Unfortunately, Sr^{85} has too short a life for very long-term turnover studies. Where Sr^{85} can be used, however, measurement with the whole-body counter appears to be an excellent method of studying its retention in human subjects. (auth)

26711 FURTHER CONTRIBUTION TO THE STUDY OF THE RELATIONSHIP BETWEEN EXPERIMENTAL RICKETS AND FIXATION OF RADIOSTRONTIUM IN THE SKELETON. (a) THE EFFECT OF THE INTESTINAL ABSORPTION. (b) THE SEQUELAE RICKETS. Ugo Meldolesi and Salvatore Privitera (Universita, Catania, Italy). Radiobiol. Latina, 4: 195-205(July-Sept. 1961). (In Italian)

Influence in the rat of experimental rickets and the sequelae of rickets on the intestinal absorption of Sr^{90} were studied. In the rachitic rat, intestinal absorption of radiostrontium was reduced by 26%. In animals recovered from severe rickets, the intestinal absorption and skeletal fixation of radiostrontium were the same as in the control animals. In the former, as a result of hypoplasia and hypertrophy of the skeleton, the activity per gram or per cc. of osseous substance appeared clearly increased. Also relating their earlier findings, the authors emphasized the harmful influence of experimental rickets on the consequences of contamination with radiostrontium in the rat. (auth)

26712 CESIUM-137 IN MAN. Charles O. Onstead, Erich Oberhausen, and Frank V. Keary. Science, 137: 508-10(Aug. 17, 1962).

Measurements were made in Landstuhl, Germany, between 1959 and Sept. 1, 1961 of the Cs^{137} levels in over 6000 individuals living in Germany. The measurements were

made with the aid of a two-π liquid scintillation whole-body counter. Data are presented on age, sex, body weight, and average diet of the subjects, and Cs^{137} per kg of body weight and per gm of body K. Monthly changes in the Cs^{137} content of the population were recorded. Results of the measurements indicate a half-life of approximately 12 months for Cs^{137}. The data show that fall-out was decreasing in Western Europe up to the time when atmospheric testing of nuclear weapons was resumed in Sept. 1961. (C.H.)

26713 DIFFERENTIAL ABILITY OF TWO SOYBEAN VARIETIES TO TAKE UP Fe59 FROM SOIL ADDED TO A NUTRIENT SOLUTION. A. Wallace, R. A. Jeffreys, and V. Q. Hale (Univ. of California, Los Angeles). Soil Sci., 94: 111-14(Aug. 1962).

Hawkeye and PI 54619-5-1 soybeans were grown in solution culture to which a small quantity of calcareous soil previously labeled with Fe^{59} had been added as a source of iron and other micronutrients. The PI 54619-5-1 soybeans became chlorotic and contained a very low amount of Fe^{59} in leaves. Differences in roots were less pronounced. When the two soybean varieties were grown together in the same solution the PI 54619-5-1 inhibited Fe^{59} uptake by the Hawkeye, but the Hawkeye had no influence on Fe^{59} in the PI 54619-5-1. Hawkeye and PI 54619-5-1 soybeans were also grown in soil-solution mixtures containing Fe^{59} with added organic chemicals that are believed to be commonly excreted by plant roots, and in mixtures with soils of varying pH. Citrate, flavin, and glycine inhibited Fe^{59} uptake with Hawkeye soybeans. With PI 54619-5-1 soybeans, the uptake was so low that the chemicals caused no further inhibition. EDDHA resulted in large increases in Fe^{59} uptake in roots and tops of both varieties, but that in leaves was twice as high for the Hawkeye. Soils of high pH resulted in decreased uptake of Fe^{59} for both soybean varieties, but a high pH decreased Fe^{59} uptake more with the PI 54619-5-1 soybean than with Hawkeye. (auth)

26714 THE RETENTION AND TRANSLOCATION OF INHALED $Pu^{239}O_2$ PARTICLES. W. J. Bair, D. H. Willard, and L. A. Temple (General Electric Co., Richland, Wash.). Trans. Am. Nuclear Soc., 3: 536-7(Dec. 1960). (HW-SA-1989)

Mice exposed to $Pu^{239}O_2$ aerosols deposited about 20% of the amount inhaled in lungs. From 40 to 60% was distributed between the nasal and oral passages and the gastrointestinal tract. Although the major portion of the body burden was associated with the lung, during a 70 week period there was gradual translocation to the skeleton, muscle, liver, and spleen. The skeleton accumulated the largest quantity of translocated Pu^{239}, about 0.3% of the total dose. This was equal to the amount remaining in lung. The half-life for clearance of about four % of the Pu^{239} initially deposited in the lung was 460 days. The remainder was cleared with half-lives of 20 days or less. Assuming uniform distribution after deposition of 0.02/uc Pu^{239} in the lung, the total alpha dose to mouse lung tissue during the 70 week period was 550 rad. (auth)

26715 ISOTOPE METHODS OF ANALYZING A LIVING ORGANISM. N. A. Gabelova. p.338-47 of "Elektronika v Meditsine." Moscow, Gosenergoizdat, 1960.

A 4-channel radiograph was designed, in which non-linear integral recording with continuous printing in time of gamma radiation is used. The non-linear dependence of indications on the gamma radiation intensity permits a stronger contrasting of sections. It is thus possible to carry out investigations at much smaller radiation doses than those when a collimation counter is being used. The non-linearity of the radiograph indications makes possible automatic control of pulse amplitudes depending on frequency, the integrating current being approximately proportional to the square of intensity of gamma radiation which penetrates the crystal of the luminescent counter. Results of the radiograph for the study of limb blood supply are described. Mention is also made of a new scanning device called a gamma graph. (Referativnyy Zhurnal, 7: No. 6, 1961)

26716 QUESTIONS OF THE MIGRATION OF RADIOACTIVE STRONTIUM IN COWS WITH CALF. N. I. Burov. p.88-94 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

The resorption and excretion of Sr^{90} in cattle and its transfer to the calf embryos were studied. Three pairs of cows, 4, 7, and 9 months with calf, were injected intravenously with 276 μC of Sr^{90} mixed evenly with Y^{90}. A fourth pair of cows, 6 months with calf, had 2860 μC of strontium and yttrium administered directly into the rumen. The strontium content in the excreta was studied for 15 days from the start of the tests. One calf from each pair was also killed and studied for Sr^{90}. It was found that the resorption of strontium from the intestine in pregnant cows did not differ appreciably from that in non-pregnant cows and was calculated at 6-12%. The transfer of strontium into the milk varied directly with the cow's daily milk yield. Over a period of 15 days various cows with a total yield of 31.1, 109, 154, and 164 liters excreted 5.13, 9.83, 10.2, and 10.33% of strontium with the milk. Transfer of strontium into the urine in pregnant cows (13-17.58%) was less than in non-pregnant cows (26% of the amount administered). Transfer of strontium from the mother cow into the embryo varied directly with the stage of pregnancy. With a pregnancy 4, 7, and 9 months advanced, the deposition in the calf's skeleton was 1.685, 5.182 and 13.3%, respectively of the strontium that entered the cow's blood. In the cow (6 months pregnant) which received strontium per os, 0.435% of the strontium which entered its gastrointestinal tract was deposited in the calf's skeleton. (OTS)

26717 THE EFFECTS OF THE CALCIUM NOURISHMENT LEVEL OF LACTATING COWS ON THE EXCRETION OF RADIOACTIVE FISSION PRODUCTS WITH THE MILK. B. N. Annenkov. p.95-100 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

The results of research on the general laws governing the excretion of radioactive fission products with the milk after chronic administration of fission isotopes with the feed, and also the effects of excess calcium in the fodder ration on the udder's excretion of radioisotopes are given. The tests were carried out on cows in the 7th-8th month of lactation. Their feed was arranged to ensure a calcium deficit of 20-70 g/day; one group of cows received no mineral additive to correct the deficiency, while two other groups of cows received 50 g (normal calcium content) or 200 g (calcium surplus) of additive. The excretion of radioactive fission products with the day's milk yield comprised 0.61-1.53% of the dose. It was found that excess calcium in the feed ration did not reduce the contamination of milk with radioactive fission products. The concentration of these fission products and Sr^{90} in a liter of milk comprised respectively, 0.126-0.153 and 0.16-0.175% of the daily dose. The total excretion of fission products and Sr^{90} with the milk depends on the cow's yield; in high-yield cows it can be as much as 2.74% and 3.2% respectively of the amount of isotope administered. Discrimination of Sr^{90} as compared to calcium was noted, with transfer of Sr^{90} from the fodder to the milk. The discrimination factor with a shortage or

normal amount of calcium in the feed ration ranged from 0.087 to 0.093. With surplus calcium the discrimination factor was 0.219. (OTS)

26718 THE TOXICOLOGICAL ACTION OF STRONTIUM ON ERYTHROCYTES IN RATS. Z. I. Kalmykova. p.101-10 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

Strontium-90 was injected intraabdominally as follows: group I—1000 μC single dose; group II—100 μC single dose; and group III—100 μC spread out over 100 days (10 μC every 10 days). In all animals a study was made of: the erythrocyte and reticulocyte counts, the total volume of erythrocytes, the mean volume of each erythrocyte, and the erythrocytes' osmotic pressure. It was found that single administration of 1000 μC led to changes in the dimensions and osmotic resistance of the erythrocytes which increased with time and culminated in spontaneous hemolysis after one week and in a drop in the erythrocyte count after two weeks. With a single dose of 100 μC moderate changes developed in the red blood. With protracted administration of the same dose the changes were more marked. All means of introducing strontium into the blood serum led to the appearance of toxic properties which favored hemolysis; the appearance of these properties coincided with the greatest degree of lesions to the erythrocytes. The changes in the red blood at 1000 μC were at all stages the result of primary beta radiation and of secondary beta radiation expressed through the toxic properties of the plasma. With the optimum carcinogenic dose these changes resulted from primary radiation in the early stages, while in the later stages they were caused by the state of the bone marrow in conjunction with the plasma's toxic effects. It is concluded that the changes may serve as an indication to the degree of damage of the red blood due to the entry of Sr^{90} into the body. (OTS)

26719 THE DISTRIBUTION AND EXCRETION OF PLUTONIUM IN DOGS AT REMOTE DATES AFTER ITS INTRODUCTION. T. N. Rysina and R. A. Yerokhin. p.119-27 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

The distribution and excretion of plutonium in dogs at remote dates after its introduction was studied to derive mathematical equations covering the behavior of plutonium in various organs and tissues and to assess the possibility of determining its total content from excretion data. The tests were run on dogs injected intravenously with $Pu(NO_3)_4$ solution. To simulate chronic radiation sickness the dogs were injected 4 times at monthly intervals. The total dose of plutonium was 0.2 μC/kg of the animal's weight. Plutonium distribution was studied 3, 6, and 11 months, and 3, 3.5, and 4 years after its introduction. Both exponential and power models were used for the mathematical description of the behavior of plutonium in the body, tissues, and excreta, but the exponential method was found to conform best with the experimental findings. Mathematical calculation of the expressions was accomplished by the method of least squares. The distribution was as follows: skeleton 40%, liver 30%, muscles 2.4%, spleen 2.3%, lungs 0.45%, kidneys 0.36%. In all organs radioactivity decreased with time. In the spleen it dropped to 0.49% by the 600th day and in the kidneys to 0.12% by the 1000th day. Subsequently the plutonium content in these organs remained constant. The data from the excretion of plutonium are broken down into 2 periods: 2nd-23rd day and from the 23rd day onward. For the first 3 weeks plutonium excretion in the stools was higher than excretion in the urine. At later stages excretion in the urine was 2-3 times that in the stools. The correlation between the basic quantities of radioactive element in the skeleton and the liver remained invariable at 1.34. This justifies the attempt to find a constant governing the excretion of plutonium from the system. Coefficients of excretion (the excretable fraction of plutonium expressed as a percentage of that contained in the body) were calculated to assess the plutonium content in the body. Using the expressions for the coefficient: $K_{excr} = 0.206e^{-0.48t}$, $2 \leq t \leq 23$, and $K_{excr} = 0.0327e^{0.031t}$, $t \geq 23$, the plutonium content in a dog can be assessed from the daily total of plutonium excretion. (OTS)

26720 THE DISTRIBUTION OF PLUTONIUM IN THE LIVER ACCORDING TO THE RESULTS OF HISTOAUTORADIOGRAPHY. V. K. Lemberg, Z. M. Bukhtoyarova, and A. P. Nifatov. p.136-44 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

The micro-distribution of Pu^{239} in the liver and bones of white rats was studied by histological slides fixed on a photographic emulsion. Plutonium-239 was introduced intraabdominally as $Pu(NO_3)_4$ in a single dose of 7 μC/kg at pH = 2. After 6 and 12 hours, and 1, 3, 7, 14, 28, 41, 56, 88, and 225 days the rats were decapitated and slides of the bone and liver tissues prepared. A detailed analysis of the photos showing the tracks of plutonium alpha particles at various stages after the introduction of plutonium-239 is given and the results of the experiments are compared with various other findings. The histoautocardiograms showed a definite redistribution of plutonium in the structural elements of the bones and liver. Within 6-12 hours after its introduction, diffuse distribution of plutonium in all structural parts of the liver was noted. Subsequently, from 1-225 days, the plutonium content in the hepatic cells decreased and began to accumulate in the Kupffer's cells and the macrophages of the perivascular connective tissue. Six to 12 hours after its introduction, the bones contain only a small amount of diffusely distributed plutonium (bone marrow, compact substance and diploë). By the end of the 3rd day a marked increase was noted in the plutonium content of the bone marrow. At subsequent stages the plutonium content in the bone marrow gradually diminished, but increased in the endosteum and periosteum. Some plutonium, however, was retained in the compact bone throughout the whole period. (OTS)

Fallout and Ecology

26721 (HW-tr-41) STUDY OF THE CONTAMINATION AND ABSORPTION OF Sr^{90} AND Cs^{137} BY PROCHILODUS PLATENSIS (SHAD). Leopoldo Jose Anghileri (Argentina. Comisión Nacional de Energia Atómica, Buenos Aires). Translated by Liz Appleby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.) from report NP-9368. 1960. 9p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 28982.

26722 RADIATION LEVELS IN SELECTED REGIONS OF BRAZIL. Francisco X. Roser and Thomas L. Cullen (Catholic Univ., Rio de Janeiro and Fordham Univ., New York). Anais acad. brasil. cienc., 34: 23-35(1962). (In English)

A summary is given of the radiation levels produced by natural contamination in the ground and air in Brazil regions. The regions surveyed include monazite sand and volcanic intrusives, and measurements were made above

the ground and on streets, buildings, beaches, breath, and in field. (D.L.C.)

26723 EXAMINATION OF RADIOACTIVE PARTICLES FROM THE YEAR 1961 ("HOT PARTICLES"). B. Rajewsky, Th. Franke, E. Groos, J. Heyder, A. Kaul, W. Lippert, and M. F. Rajewsky (Max-Planck-Institut für Biophysik, Frankfurt am Main). Atompraxis, 8: 237-57 (July 1962). (In German)

Radioactive particles from fallout in the autumn of 1961 were examined gamma-spectrometrically, radiochemically, electron-optically, and x-ray-microanalytically. Activities of up to several 10^{-9} curies per particle were found. Gamma-spectrometric and radiochemical analysis revealed the following components in most of the particles examined: Zr^{95}/Nb, Mo^{99}, I^{131}, Te^{132}/I, Ba^{140}/La, Ce^{141}, Ce^{144}, and Nd^{147}. In the fallout samples examined at the same time, U^{237} and Np^{239} could also be demonstrated as induced radionuclides. The radioactive particles shown electron-microscopically have a mean maximum diameter of 4μ. The ratio of the largest diameter to the smallest averages 1.1. There are indications of the presence of crystalline structures. Electron-optical illustrations of three fragments of a mechanically destroyed radioactive particle showed a clear agreement in the form of their outlines. Fe and Al (or Si) were found to be the inactive components of a radioactive particle by means of an x-ray microanalytical method using electron-microscopy. The question of radiation stress caused by radioactive particles is also discussed. (auth)

26724 NATURAL AND ARTIFICIAL AIR RADIOACTIVITY IN THE ALPS AT DIFFERENT HEIGHTS. Reinhold Reiter. Ber. deut. Wetterdienstes, No. 54: 38-53(Sept. 1958). (In German)

Since 1956, the natural radioactivity of the atmosphere has been determined several times a day in a valley of the North Alps (Farchant, elevation 675 m) whereby the disintegration products of radium and thorium emanation have been measured separately. In addition the artificial radioactivity of the air has been observed at several hours a day since the beginning of 1957. Another station simultaneously carries out records at 1780 and/or 2650 m above sea level. Both stations are situated at a horizontal distance of only a few kilometers. The data obtained with these stations and particularly their comparison result in an insight in the vertical distribution of the natural and artificial substances in the atmosphere under different meteorological conditions and particularly with a view to the specific meteorology and geology of the Alps. (auth)

26725 NATURAL RADIOACTIVE ELEMENTS IN PLANTS. A. L. Kovalevskii (Siberian Scientific Research Inst. of Geochemistry, Novosibirsk). Izvest. Sibir. Otdel. Akad. Nauk S.S.S.R., No. 4, 108-14(1962). (In Russian)

Selective absorption of Ra, U, and Th isotopes by plants and the radioactive equilibrium of Ra isotopes and their decay products were studied. The accumulation of U, Ra, and other rare-earth elements by plants is determined by chemical rather than radioactive properties. In spite of the fact that the number of β decays from natural radioactive element exceeds (by a factor of 3) the number of α decays, the ionization of living tissue by α particles exceeds that by β particles, especially in leaves, flowers, and young shoots. The mesothorium and ThX (Ra^{224}) α emitters are prevalent in plants. (R.V.J.)

26726 JAPANESE DIETARY HABITS AND THE FALL-OUT PROBLEM. Yoshio Hiyama (Univ. of Tokyo), Hiroshi Hayami, Noboru Yamagata, Hironobu Wantanabe, Ryushi Ichikawa, Kiyoshi Kodaira, and Rinnosuke Fukai. J. Radiation Research (Japan), 3: No. 1, 16p. (Mar. 1962). (A/AC.82/G/L.763). (In English)

As data coming out from Japan on the level of contamination of food by radioactive fallout from the nuclear weapon tests often differs remarkably from that obtained in other countries, an investigation was made to find the radioecological reason for it. Less contribution of milk to total diet than European and American countries was found in Japan where various kinds of food of plant origin contribute significantly and the level in the total diet only can be taken as standard because that in milk or in other food can not be a proportional to it. As more seasonal products are taken than continuous products in Japan, the mean storage time in diet is roughly measured as half a year. From the relation between the fallout level on ground and in the diet, a rough measure was made of the Sr^{90} and Cs^{137} level in the total diet using the accumulated ground deposit and the fall-rate in Tokyo. These differences between Japan and others are thought to be caused by the difference of usage of land surface for food production. (auth)

26727 ENVIRONMENTAL CONTAMINATION WITH SHORT-LIVED RADIO-NUCLIDES IN JAPAN IN 1961. Noboru Yamagata and Kiyoshi Iwashima (Inst. of Public Health, Tokyo). J. Radiation Research (Japan), 3: No. 1, 15p.(Mar. 1962). (A/AC.82/G/L.764). (In English)

Measurements were made on the radioactivity of dust, foodstuffs, lungs, and thyroids of man and animals from October to December 1961. The concentration of I^{131} in air showed a maximum of 2.07 $\mu\mu c/m^3$ on November 6 and the average for the second half of November was 0.62. The value decreased to less than 0.2 in December. Spinach samples showed remarkable contamination with fission products, the maximum being 16 mμc of I^{131} per fresh kg. Average intake of I^{131} by population through ingestion of leafy vegetables was estimated as 100 to 300 $\mu\mu c$ in November and 7 to 20 $\mu\mu c$ in December. The contribution of milk in daily intake was less than 10% of that of leafy vegetables which was considered the main channel of transmittance of I^{131} to the human population of Japan. A greater risk would be involved to breast-fed baby than bottle-fed one since the latter consumes canned powder milk in Japan and the former would be greatly influenced by its mother's diet composition. The level of I^{131} in human thyroids from 52 persons who died during the period December 4 to 12 in Tokyo was less than 5.6 $\mu\mu c$/fresh g on the average; the thyroid burden was estimated as 100 to 165 $\mu\mu c$ of human population in the period November and December 1961. (auth)

26728 RADIOACTIVE FALLOUT AND TRANSPORT OF ACTIVITY THROUGH FOOD CHAINS. Lars Fredriksson. Kgl. Skogs- och Lantbruksakad. Tidskr., 101: Nos. 1-2, 109-18(1962). (In Swedish)

Some elementary information about atomic structure, binding energy in different atomic nuclei, fission and fusion processes, types of radiation and its absorption in living tissue is given. Some aspects of the biological effects of different radiation doses are also given. The general distribution of the fission products from nuclear tests in the atmosphere is briefly discussed. The big risks for heavy local fallout within large areas from explosions near the earth surface are emphasized. A discussion is given on possible practical emergency measures in agriculture in case of heavy fallout. It is clearly pointed out that the fallout in Sweden has up to now not justified any practical measures in agriculture, and it is extremely unlikely that the nuclear testing last fall would change the present situation. In case of a nuclear war, however, special emer-

gency measures in agriculture will be very important. The possibilities of continuing the food production necessary to sustain the people might well be highly dependent on such measures. Two different fallout situations are considered, namely: 1. Local fallout, characterized by fresh fission products chiefly consisting of nucleides with short half-lives. The intense external gamma radiation is in this case the main danger and protection from this in the best available radiation shelter will be the most important for man as well as for animals. 2. World-wide fallout (tropospheric and stratospheric). In this case the main problem will be to prevent such radionucleides as I^{131}, Sr^{90} and Sr^{89}, and Cs^{137} from being transported from the atmosphere and the soil through the food chains to man and animal. Tracer experiments in Sweden have shown that different soil treatments can reduce the accumulation of Sr and Cs in vegetation appreciably. On pasture land most of the activity deposited in the surface layer of the soil can easily be removed by a special mechanical technique worked out in the experiments. (auth)

26729 X-RAY MICROANALYSIS OF A RADIOACTIVE PARTICLE WITH THE AID OF THE ELECTRON MICROSCOPE. Manfred F. Rajewsky (Max Planck Instut für Biophysik, Frankfurt am Main). Nature, 195: 369-70 (July 28, 1962).

A radioactive particle was analyzed to discover the composition of the inactive material of the particle. The method uses the x-ray line spectrum of the K series caused by electron irradiation of the particle in the electron microscope. Iron and aluminum or silicon (the last two could not be distinguished) were found as inactive components in the particle. (D.L.C.)

26730 RADIUM AND FISSION PRODUCT RADIOACTIVITY IN THERMAL WATERS. L. M. Fry (Univ. of Arkansas, Fayetteville). Nature, 195: 375-6(July 28, 1962).

Water samples collected in Oct. and Nov. 1960 from Buie Springs, Marlin, Texas and Hot Springs, Ark. were analyzed for radium, Ba^{140}, Sr^{89}, and Sr^{90}. All activities were very low except Ra^{226} and Ra^{228}. (D.L.C.)

26731 RADIOACTIVE ISOTOPE STUDIES. Oceanus, 8: No. 1, 20-4(Sept. 1961).

The program for analysis of long-lived radioisotopes from fallout in the Atlantic Ocean is described. Sampling problems and the expected movement patterns of Sr^{90}, Ce^{144}, Pm^{147}, and Cs^{137} in the ocean are discussed. The results for Sr^{90} in 1957 and 1958 show that more Sr^{90} was found below 100 m than above that depth and that about three times more Sr^{90} per unit area was found in the ocean than on land at comparable latitudes. Ce^{144} and Pm^{147}, which were expected to associate with particles and to separate from the other radioisotopes, were found to separate from each other as well, Ce^{144} tending to stay longer in the upper layers. It is concluded that Pm^{147} associates with inorganic particles sinking at rates >100 m per month, while Ce^{144} associates with organic particles. The CHAIN 17 cruise of RV CRAWFORD around the Romanche Trench is described; the analyses of the ocean samples collected on this cruise are now in progress. (D.L.C.)

26732 A DEEP-WATER GAMMA RADIOMETER AND MEASUREMENT OF THE RADIOACTIVITY OF THE DEEP-WATER LAYERS OF THE INDIAN OCEAN. L. M. Khitrov and K. A. Kotlyarov (Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Okeanologiya, 2: 334-45(1962).

The problem of the quantitative study of radioactive isotopes in the ocean is reviewed. The importance of this problem is enhanced by the fact that 90% of all radioactive products resulting from nuclear tests fall in the ocean and are carried to different areas by currents. Numerous measurements of radioactivity were previously made in the surface layers of the ocean but no systematic studies were made at great depths. A deep-water gamma radiometer which was developed for measurement of radioactivity at great depths in the ocean is described. During measurements of the gamma background in deep parts of the central and northern Indian Ocean in 1960 no increase in the level of radioactivity was found which exceeded the natural level by more than 2 or 3 times. All of the recording apparatus is incorporated with the detector in a single capsule which is lowered to the required depth using an ordinary winch. The absence of an electric cable connecting the capsule to the mother vessel reduces interference and simplifies operation. On the other hand there is no way to control the underwater instruments and the readings remain unknown until the capsule is recovered. The radiometer is stable with respect to temperature and humidity, resistant to corrosion, and insensitive to possible blows it may suffer. It will operate in a temperature range from +40 to −5°C. A block diagram of the radiometer and a circuit diagram are given. A 30 × 10 mm sodium iodide crystal is used. The design and operation of the radiometer are described. The results of radioactivity measurements in the Indian Ocean are given. (OTS)

26733 RADIOACTIVE FALLOUT FROM NUCLEAR EXPLOSIVES AND SHELTERING AGAINST THEM. Jorma K. Miettinen. Teknillinen Aikakauslehti, 52: No. 2, 38-43; 46(1962). (In Finnish)

In peacetime nuclear tests the weather conditions are carefully considered, but it can hardly be assumed that during a war any attention can be paid to the potential danger in neighboring countries due to radioactive fallout. For this reason even such neutral states that do not consider it appropriate to spend sufficient means on structural protection of the population in primary targets of nuclear attack should be well aware of the implications of radiological protection of the population. The necessity of training investigative personnel is mentioned as a particularly important factor in this respect.

Radiation Effects on Living Tissues

Refer also to abstract 27469.

26734 (NP-11847) TWO SEQUENTIAL TWO-SAMPLE GROUPED RANK TESTS WITH APPLICATIONS TO SCREENING EXPERIMENTS. Technical Report No. 3. Frank Wilcoxon, L. J. Rhodes, and Ralph A. Bradley (Florida State Univ., Tallahassee). May 1962. Contract NONR-988(08). 33p.

Two sequential two-sample grouped rank tests are developed and designated as the Configural Rank Test and the Rank-Sum Test. For both tests, observations are taken in groups of m X-observations and n Y-observations with the observations ranked within the groups. The sequential procedures relate to the usual decisions at the end of each group, namely to accept a null hypothesis, to accept an alternative hypothesis, or to take another group of observations. The hypotheses involved are $H_0: G(x) = F(x)$ and $H_1: G(x) = F^k(x)$ when $F(x)$ is the cumulative distribution function of the X-population and $G(y)$ that for the Y-population. The implications of these hypotheses are discussed. The sequential methods are direct applications of Wald sequential analysis. The configural rank test depends on a probability-ratio statistic based on probabilities of the

particular configuration of ordered observations obtained; the rank-sum test uses the within-group rank sum for the Y-sample and probability ratios based on the probabilities for the rank sums. Extensive tables for the rank-sum test are given. An algorithm for easy use of the configural rank test is provided. Values of the operating characteristic functions and of the average sample number functions for the two tests are given with discussions of the properties of the tests. A screening experiment for the effects of chemical compounds for possible amelioration of the harmful action of radiation exposure is described and applications of the methods to such an experiment are illustrated. (auth)

26735 (NYO-2760) RESUMES OF FINDINGS FROM INDIVIDUAL CASE STUDIES—EPIDEMIOLOGICAL FOLLOW-UP OF RADIUM CASES. Progress Report. (New Jersey. State Dept. of Health. Radium Research Project, West Orange). July 1, 1962. Contract AT(30-1)-2181. 210p.

Resumes of the findings of 104 cases under investigation by the Radium Research Project of the New Jersey State Department of Health in the course of its epidemiological follow-up of radium cases are presented. The 104 individuals comprise the first group to have undergone the basic evaluation for the purpose of determining the long-term effects of radium on man. The resumes contain information from occupational, family, and medical histories. Also included are diagnoses and impressions from medical, dental, roentgenographic, clinical laboratory, and post-mortem examinations, as well as an estimate of the body burden of radium-226 and radium-228 of each case. (auth)

26736 (TID-15330) BIOLOGICAL EFFECTS OF RADIATION, AND RELATED BIOCHEMICAL AND PHYSICAL STUDIES. Summary Progress Report, July 1, 1950–October 31, 1961. (Sloan-Kettering Inst. for Cancer Research, New York). Jan. 31, 1962. Contract AT(30-1)-910. 125p.

Progress is reported in studies on the metabolism of iodine and I^{131}-labeled compounds in man, metabolic studies with Ca^{47} and Sr^{85} in patients with bone disease, intermediary metabolism studies with labeled nucleic acid precursors, and studies on the metabolism of steroid hormones in man. Electron spin resonance spectroscopy was used in studies of free radical production in irradiated compounds of biological importance, measurements were also made of secondary electron spectra produced by γ rays in water. The accomplishments of these, and supporting projects are summarized. A bibliography of major publications is appended. (C.H.)

26737 (TID-16026) MODIFICATION OF GENETIC DAMAGE PRODUCED BY IONIZING RADIATION. Annual Progress Report and Renewal Proposal for the Period September 1, 1962 to August 31, 1963. Irwin I. Oster (Institute for Cancer Research, Philadelphia). Contract AT (30-1)-2618. 13p.

Progress is reported in studies on the genetic effects of radiation in drosophila. Several innovations and techniques are described that were introduced with a view to increase the degree of refinement in the detection of induced hereditary changes. (C.H.)

26738 (TID-16328) THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. A Supplementary Report. Carl C. Moh (Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica). July 1, 1962. Contract AT(30-1)-2043. 28p.

Preliminary results are reported from studies on the radiosensitivity of cuttings, tubers, whole plants, or seeds of cassava, rubber, cocoanuts, pine trees, beans, and guinea grass. The feasibility of releasing radiation-sterilized males in an attempt to eradicate the Mediterranean fruit fly in Central America was investigated. Results of some preliminary radiation experiments are reported. Installation of a Co^{60} γ source is reported. (C.H.)

26739 (TID-16376) THE BIOLOGIC EFFECTS OF RADIATION ON THYROID TISSUE. Annual Progress Report, September 15, 1961 through September 14, 1962. Oliver Cope (Massachusetts. General Hospital, Boston). July 20, 1962. Contract AT(30-1)-667. 9p.

A survey was made of patients who received radiation therapy of the thyroid gland from 1941 through 1949 for possible carcinogenic effects of the radiation in the gland itself. The induction of leukemia and genetic effects in the irradiated patients were also considered. Data are tabulated on 93 patients, in whom 9 tumors, benign and malignant, were found. Results are included from a study of thyrotropic suppression by thyroid medication in selected subjects and calculations of gamma absorption in patients undergoing isotope therapy. (C.H.)

26740 (TID-16395) A STUDY OF THE EFFECTS OF X-RAYS ON THE BONES OF LIVING MICE. Progress Report, October 1, 1961–July 1, 1962. Helen Q. Woodard (Sloan-Kettering Inst. for Cancer Research, New York). July 20, 1962. Contract AT(30-1)-910. 5p.

Studies were made on the effects of x rays on the composition of the tibias of mice. One tibia of each of a series of albino female mice was given an exposure dose of 1200, 1600, or 2000 r of 180 kvp x rays, the remainder of the animal, including the other hind leg, was shielded. At various times up to four months after irradiation the mice were killed, and both tibias were dissected and analyzed. In the group receiving 1600 r, the irradiated tibias lost protein and water, and recovery was complex and incomplete. The irradiated tibias also showed a severe and permanent decrease in ability to metabolize alkaline phosphatase or to fix Sr^{89} over 24 hr periods. In a control group maintained in a hyperthyroid state, it was found that thyroid hormone stimulates both anabolism and catabolism in bone. In almost every case, it was found that radiation damage to the catabolic process was greater than that to the anabolic process. (P.C.H.)

26741 (FTD-TT-62-657) THE ACTION OF SMALL DOSES OF IONIZING RADIATION ON PHYSIOLOGICAL FUNCTIONS. C. G. Kocherezhkin. Translated from Vestnik Akad. Nauk S.S.S.R., No. 10, 136-7(1961). 6p.

A summary is given of the conference held in Moscow in May 22 through 24, 1961, on the problems of the action of small doses of ionizing radiation on physiological functions. The papers presented were primarily concerned with the effect of small doses, a dose close to the threshold minimally affecting the irradiation function, on the various aspects of the activity of the central nervous system. (N.W.R.)

26742 (FTD-TT-62-831) INCREASING THE RADIORESISTIVITY OF NERVE TISSUE WITH THE AID OF THIAMINE PREPARATIONS COMBINED WITH NARCOTICS. P. F. Minaev (Minayev), P. Moschinskii (Moshchinskiy), and E. (Ye.) P. Skorobogatova. Translated from Doklady Akad. Nauk S.S.S.R., 143: 976-9(1962). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 18775.

26743 (JPRS-14762) CONCERNING THE CANCEROGENIC PROPERTIES OF SOME RADIOACTIVE COMPOUNDS AT A REMOTE PERIOD OF THEIR ACTION. T. A. Kochetkova, G. A. Avrunina, and N. D. Sagaydak.

Translated from Arkh. Patol., 24: No. 5, 3-7(May 1962). 12p.

The effects of Na^{24} in the form of a solution of NaCl, P^{32} in the form of $CrPO_4$, Fe^{59} in the form of a citrate solution and oxide, and Au^{198} in the form of a colloidal solution in the lungs in white rats were studied. The administration of radioactive insoluble compounds of ferric oxide (Fe^{59}), chromium phosphate (P^{32}), and colloidal gold (Au^{198}) caused lung cancer with metastases into the pleura and regional mesenteric lymphatic nodes in 22 of 198 animals after 6 months. Soluble solutions of Na^{24}, Fe^{59}, and ferric oxide (Fe^{59}) caused no tumoral process in the lungs even after 15 to 24 months. The data indicate that it is possible for large tissue doses of radiation to occur from insoluble radioactive compounds. (P.C.H.)

26744 STUDIES ON WHOLE-BODY X-IRRADIATION EFFECTS ON ANAPHYLACTIC HYPERSENSITIVITY IN GUINEA PIGS. Š. Vlahović and V. Stanković (Rudjer Bošković Inst., Zagreb, Yugoslavia). Acta Allergol., 16: 329-36(1961). (In English)

Guinea pigs sensitized with horse serum before whole-body x-ray exposure (300 or 400 r) manifested stronger anaphylactic response than unirradiated animals, except when sensitized a few hours before irradiation. Animals sensitized after irradiation (up to 21 days) showed weaker response than unirradiated guinea pigs. Passively sensitized irradiated animals showed that irradiation did not impair the ability of guinea pigs to react anaphylactically. Moreover, they always manifested a somewhat stronger reaction than control unirradiated animals. (auth)

26745 SYNERGISM OF EXPERIMENTAL HEMOLYTIC ANEMIA AND RADIOACTIVE GOLD IN ASCITES DEVELOPMENT. P. F. Hahn and E. L. Carothers (Meharry Medical Coll., Nashville and Dept. of Health Education and Welfare, Washington, D. C.). Acta Radiol., 58: 176-85(June 1962). (In English)

There appears to be a synergistic effect of the concomitant production of experimental hemolytic anemia (induced by acetylphenylhydrazine) and the irradiation of the reticuloendothelial system as regards the production of ascites. Ascites in adult dogs was induced with fair regularity by such combined procedures, whereas with radiation alone such was relatively rare. In young pups, the advent of ascites was markedly accelerated. With the combined procedures its onset required only several weeks as contrasted with 18 to 20 weeks with radiation alone. (auth)

26746 CONVERSION OF S^{35}-L-CYSTEIN TO TAURINE AND SULFATE IN THE NORMAL AND IRRADIATED RAT. Bo Soerbo (Medical Nobel Inst., Stockholm and Research Inst. of National Defense, Sundbyberg, Sweden). Acta Radiol., 58: 186-91(June 1962). (In English)

S^{35}-l-cysteine was injected into irradiated and control rats, and the excretion of taurine and sulfate followed for 3 days. The excess taurine excreted in the irradiated animals during the first 24 hrs following radiation had about the same specific activity as that of the controls, but during the following 2 days the taurine from the irradiated animals had a higher specific activity. The total amounts of sulfate excreted were the same in both the irradiated and control groups, but the specific activity of the sulfate from the control group was higher on the second and third days. When S^{35}-taurine was injected into irradiated and control rats, the taurine excreted had about the same specific activity in both groups. The results may be explained by an initial release of preformed taurine from muscle tissue, and a secondary release of cysteine from tissue proteins in the irradiated animals. (auth)

26747 PERIPHERAL NEURAL PATHS MEDIATING AVOIDANCE OF RADIATION IN RATS. Charles D. Barnes (Univ. of Washington School of Medicine, Seattle). Am. J. Physiol., 203: 379-82(Aug. 1962).

The number of seconds per minute that male rats electively spent in a chamber x irradiated at 32 r/min was measured in four groups: normal animals, animals which had received an intraperitoneal injection of 1 ml of 0.5% procaine, animals which had undergone bilateral splanchnicotomy, and sham-operated animals which had undergone all procedures preparatory to splanchnicotomy and which received 1 ml of distilled water intraperitoneally just before a test. Normal and sham-operated animals exhibited avoidance of radiation within 5 min of exposure, whereas splanchnicotomized or procainized rats showed no avoidance during the first 20 min of a 40-min test. It is suggested that an early component of radiation avoidance is mediated by splanchnic impulses elicited by the breakdown of the mucosa of the duodenum, small intestine, and, possibly, the stomach; and that breakdown of more resistant portions of the gastrointestinal mucosa (in the mouth, esophagus, and rectum) contributes to a late component. (auth)

26748 EFFECT OF SEGMENTAL INTESTINE SHIELDING ON MORTALITY FROM INTESTINAL RADIATION. J. Chandler Smith (Western Reserve Univ., Cleveland). A.M.A. Arch. Pathol., 70: 94-102(July 1960).

Experiments were made to determine whether the absorptive function of the ileum is responsible for the protective effect of ileum shielding against acute intestinal radiation syndrome. A segment of the ileum was surgically isolated in some rats, the vascular supply being left intact and the continuity of the intestine being re-established by anastamosis of the transected ends. Irradiation experiments on operated and unoperated rats showed that shielding of a segment of ileum in continuity with the rest of the small intestine protected against radiation of the abdomen with 1,000 r, while shielding of a segment of isolated ileum did not. It is concluded that the protective effect of segmental intestine shielding is the reabsorption of fluids and electrolytes through the intact mucosa of the shielded part and that the intestinal radiation syndrome may be treated by restoration of fluid and electrolyte balance. (D.L.C.)

26749 LEUKEMIA IN MAN FOLLOWING EXPOSURE TO IONIZING RADIATION: SUMMARY OF THE FINDINGS IN HIROSHIMA AND NAGASAKI, AND A COMPARISON WITH OTHER HUMAN EXPERIENCE. A. B. Brill, Masanobu Tomonaga, and R. M. Heyssel. Ann. Internal Med., 56: 590(Apr. 1962).

The occurrence of leukemia among survivors of the atomic bombings in Hiroshima and Nagasaki has been tabulated over the years from 1945 through 1958. The 209 confirmed leukemia cases which have occurred have been related to closed population samples in order to establish yearly incidence rates and to determine the dose response relationship. The data indicate that the incidence of leukemia in an irradiated population is dependent on dose in a roughly linear manner from 100 to 500 rad. The data do not allow a positive statement with regard to the presence or absence of a threshold for leukemia. There is evidence that males and the younger age groups are more sensitive to leukemia induction. The latent period for leukemia is approximately 1½ to 2 years with a maximal incidence occurring 4 to 8 years following exposure. A rough approximation of leukemia risk of 1 to 2 cases per million population per year per rad can be inferred from the data. (Public Health Eng. Abstr., 42: No. 8, Aug. 1962)

26750 GROWTH PATTERNS IN X-IRRADIATED HeLa CELLS. L. J. Tolmach (Washington Univ., St. Louis). Ann. N. Y. Acad. Sci., 95: 743-57(Nov. 13, 1961).

Measurement of the dose responses of the several parameters concerned with cell growth permits classifications of these cellular processes as either radiosensitive or radioresistant. In the former category are cell division, reproductive survival, and chromosome damage. The latter category includes general metabolic activity, cell enlargement and, possibly, the rate of cell division after radiation lag. Radiation-induced lag cannot be definitely classified but, since the effects of small doses can be detected, lag probably should be placed in the former category. Such classification is readily interpreted in terms of the concept that the primary radiation-induced lesion lies in the cell's genetic apparatus. The applicability of these findings to more normal cell types in vitro, and to in vivo cell systems remains to be tested. (auth)

26751 X-RAY EFFECTS ON CULTURED HUMAN AMNION CELLS. Joergen Fogh, June Lee Biedler, and A. R. T. Denues (Sloan-Kettering Inst. for Cancer Research, New York and Cornell Univ. Medical Coll., New York). Ann. N. Y. Acad. Sci., 95: 758-73(Nov. 13, 1961).

The early effects of 100 kv x rays on monolayers of continuously grown human amnion cells of strain FL include loss of continuity of the cell sheet, reduction in number of cells, gradual increase in cell size, and decrease in occurrence of mitotic figures. For doses examined in the range 300 to 3000 r, the increase in cell size was accompanied by a greater range of volumes. Cell enlargement, interpreted as continued cellular growth under the condition of inhibited cell division, was reflected in the nucleus as well as in the cytoplasm. The largest giant cells were present 4 days after irradiation. Mitotic figures did not occur in giant cells. Cytoplasmic changes in the irradiated cells included enlargement, vacuolization, and formation of empty-looking, rather structureless areas, mainly perinuclear, that may figure in the separation of cytoplasm and nuclei. Prominent ergastoplasm and well-preserved mitochondria and Golgi complexes were seen within the irradiated cells, but a bubbling at the cell surface with suggested blebs containing well-preserved endoplasmic reticulum suggested a sudden dissolution of the cell. Nuclear anomalies included increased number of nuclei as well as marked changes in size and shape. Budding and break-off of nuclear material, wrinkling, and irregularities of nuclear membrane, lobulation, and vacuolization were frequently observed. The multinucleate cells occurred frequently and, apparently as a late stage, the nuclei seemed to explode into numerous spheroidal masses. The nuclear RNA was seen to take all sizes and, especially at the earlier stages of change, was characteristically in the form of irregular enlarged nucleoli. A central zone of relatively structureless material was often observed within the nucleoli and some evidence of their unraveling was seen. In multinucleate cells, small nucleoli were seen within some micronuclei. Surviving cells from cultures exposed once or twice to 1000 r showed no striking difference in growth behavior of x-ray resistance from the parent culture. The chromosomes of FL cells displayed responses to radiation that ranged from simple breakage to marked fragmentation, with increased dose of radiation, and included complicated structural rearrangements. (auth)

26752 ATTEMPTS AT INFLUENCING THE RADIATION RESPONSE OF HUMAN TUMOR STRAINS A.Fl. AND HeLa IN CONTINUOUS CULTURES: A TEST OF SYNKAVIT (SYNTHETIC VITAMIN K) AS "RADIOSENSITIZER." Annelies Schleich, Margaret K. Gey, and George O. Gey (Johns Hopkins Univ., Baltimore). Ann. N. Y. Acad. Sci., 95: 774-95(Nov. 13, 1961).

Two human cell strains, the adenocarcinoma HeLa and the fibrosarcoma A.Fl. were used for tests on the possible radiosensitizing capacities of the synthetic vitamin K Synkavit. Concentrations of 4×10^{-6} and 4×10^{-7} have been tolerated by the human-tumor cells. No remarkable enhancement of radiation effect could be obtained in these studies. The tumor tissue pretreated with Synkavit showed less destruction following irradiation with x rays than after irradiation without Synkavit treatment. However, a final protection was not detectable. The responses of the A.Fl. sarcoma cells to irradiation of various doses are described. (auth)

26753 RESPONSE OF NEOPLASTIC CELLS IN VITRO TO IONIZING RADIATION. Anna Goldfeder (City of New York Dept. of Hospitals and New York Univ., New York). Ann. N. Y. Acad. Sci., 95: 796-817(Nov. 13, 1961).

A brief historical survey of radiation effects on tumor cells in tissue culture is presented. The radiosensitivity of various types of normal and neoplastic cells was studied, and cytological abnormalities in the irradiated cells, such as chromatin bridges, double anaphases in the same cell, tripolar and tetrapolar mitoses, multinucleated giant cells, nuclear and cytoplasmic vacuolization, and liquefaction of the culture medium were noted. Doses of x rays ranging from 80,000 r to 150,000 r were required for total inhibition of growth of the tissue explants in the cultures. Small doses permitted recovery. Evidence for a selective response to irradiation between various types of tissue cells, normal and malignant, is presented. Studies on a subcellular level by the aid of electronmicroscopic and microanalytic techniques revealed that the mitochondria of the more radiosensitive tumor are fewer in number and inferior in quality as compared to that of the more radioresistant tumor. The possible role these mitochondrial differences may play in cellular radiosensitivity is discussed. (auth)

26754 SURVIVAL CURVES FOR TUMOR CELLS IRRADIATED IN VIVO. Harold B. Hewitt and Charles W. Wilson (Westminster Hospital Medical School, London). Ann. N. Y. Acad. Sci., 95: 818-27(Nov. 13, 1961).

The results of in vivo studies on irradiated tumor cells were surveyed and it was concluded that they are reassuring, in the sense in which they show that the curves obtained by irradiation of cells in vitro are in no way misleading. In vitro methods have the advantage of permitting much more accurate definition of basic parameters for the irradiation of cell populations. Reviewing our rather incomplete data up to the present time, we have been impressed by the similarity of the responses of the four or five tumors we have studied, all of which may prove to conform to a single survival curve. The survival curves for numerous human-tissue cell strains irradiated in vitro that have been described by Puck et al. (1957) are also characterized by their similarities, although these workers did describe a small group difference between fibroblastic and epithelial cell types. Morkovin and Feldman (1960) showed that 6 human cell strains, including the malignant strain HeLa, conformed to a single survival curve when irradiated in vitro under well-oxygenated conditions. Moreover this curve was not significantly different from our in vivo primary curve for the mouse leukemia. Certainly no differences of survival curve slope have been described for different cell strains of man or mouse, irradiated under similar conditions, which approach the difference, for any one strain, which is attributable to the oxygen factor. The oxygen status of tumors

emerges as the paramount influence affecting the dose of radiation required to eradicate the growth potential of a tumor in vivo. In vivo systems are therefore indispensable for exploring outstanding problems in radiotherapy. (auth)

26755 QUALITATIVE AND QUANTITATIVE REACTIONS OF LYMPHOCYTES TO X RAYS. Robert Schrek (Veterans Administration Hospital, Hines, Ill.). Ann. N. Y Acad. Sci., 95: 839-48(Nov. 13, 1961).

The effect of x rays on lymphocytes of man and lower animals was studied by the slide-chamber method and the method of unstained cell counts. Large doses of x rays (4000 r or more) killed lymphocytes by delayed fixation. Moderate doses (1000 r or less) killed lymphocytes by intranuclear vacuolization. Nonirradiated lymphocytes also died by intranuclear vacuolization, but at a slower rate. Irradiation with 10 r produced a perceptible decrease in the survival time of human lymphocytes incubated at 37°C in slide chambers. Human lymphocytes were slightly more radiosensitive than lymphocytes of the rat, rabbit, and guinea pig. The effect produced by irradiation was a linear function of the logarithm of the dose. Blood lymphocytes from rats irradiated in vivo with 50 r had a shortened 10 per cent survival time: 0.75 days as compared to 2.3 days for lymphocytes from nonirradiated rats. This shortened survival time demonstrated that irradiation in vivo produced a deleterious change in circulating lymphocytes of rats. (auth)

26756 CYTOCIDAL EFFECTS OF RADIATION ON ORGAN CULTURES. O. A. Trowell (Medical Research Council Radiobiological Unit, Harwell, Berks., Eng.). Ann. N. Y. Acad. Sci., 95: 849-65(Nov. 13, 1961).

Methods are described for measuring the morphological effects of radiation on specifically radiosensitive cells of certain organs in tissue cultures. They involve accurate discrimination of cell nuclei and laborious counting. Perhaps chemical methods could be used, measuring either the loss of some cell component such as DNA or potassium, or the reduction of some metabolic parameter such as consumption of oxygen or glucose. We have tried a few of these chemical methods but thus far have not found one that can approach the accuracy of cell counting. An inherent advantage of cell counting in these organ cultures is of course that attention is confined to the radiosensitive cells; the others can be entirely disregarded unless required for computing a ratio. With chemical methods this is not possible; one has to deal with the whole culture and, if the radiosensitive fraction is small, the chemical changes will be small even when all the sensitive cells are killed. (auth)

26757 THE EFFECT OF IONIZING RADIATIONS ON MOUSE EMBRYONIC LUNGS DEVELOPING IN VITRO. Elio Borghese (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). Ann. N. Y. Acad. Sci., 95: 866-72(Nov. 13, 1961).

Results are reported from a series of studies on the effects of Co^{60} gamma radiation on tissue cultures of mouse embryonic organs differentiating in utero. The irradiation technique is described. Emphasis was placed on the radiosensitivity of developing pulmonary organs. Events observed in a time-lapse motion picture of irradiated and nonirradiated cultures and in sections made at different stages of the cultures are described. (C.H.)

26758 THE EFFECT OF X RAYS ON CELLULAR DIFFERENTIATION IN ORGAN CULTURE. Ilse Lasnitzki (Strangeways Research Lab., Cambridge, Eng.). Ann. N. Y. Acad. Sci., 95: 873-81(Nov. 13, 1961).

Radiation by a direct effect on the tissue alters the development of the vaginal epithelium from a squamous toward a mucoid type. This qualitative change in the pattern of differentiation does not seem to be either secondary to mitotic inhibition or due to a mutational effect on the nucleus, but is probably caused by an effect on the cytoplasm. This effect may be brought about via an inactivation of substances essential for keratin synthesis and facilitated by the presence of vitamin A in the natural medium. (auth)

26759 CHROMOSOMAL STUDIES ON IRRADIATED LEUKOCYTES IN VITRO. Y. Ohnuki, A. Awa, and C. M. Pomerat (Pasadena Foundation for Medical Research, Calif.). Ann. N. Y. Acad Sci., 95: 882-900(Nov. 13, 1961).

The technique for the cultivation of human leukocytes with the use of heparinized venous blood treated with phytohemagglutinin is described. With this method chromosome spreads were made from 6-day cultures using the colchicine-hypotonic sodium citrate-acetic orcein-squash sequence. The range of polyploidy was determined on 2 specimens for each of 3 individuals. Detailed analyses and counts of human chromosomes indicated the predominant distribution to be euploid cells having 46 chromosomes. Idiogram studies showed the same basic pattern demonstrated by previous investigators. These data served as a basis for comparing results obtained from sister cultures irradiated with 400 r from a cobalt-60 source on the fourth day and fixed on the sixth day. Under these experimental conditions there was a considerable increase, 6.3%, in the number of polyploid cells. Among these, tetraploid cells were the most frequent, being 5.4%. By chromosomal analyses, 56.6% of the cells were found to be damaged. Most injuries were due to chromosomal breakages, especially fragments and dicentrics. Endoreduplication also was noted frequently. (auth)

26760 THE EFFECT OF X IRRADIATION OF THE PROGRESS OF STRAIN U-12 FIBROBLASTS THROUGH THE MITOTIC CYCLE. Helen Harrington (Western Reserve Univ., Cleveland). Ann. N. Y. Acad. Sci., 95: 901-10(Nov. 13, 1961).

The effect of irradiation on Strain U-12 fibroblasts was studied. The administration of 500 r inhibited mitosis almost immediately, whereas the specific activity of DNA and the number of cells synthesizing DNA were not reduced markedly until 18 to 24 hr following the irradiation. RNA synthesis was not reduced at any interval observed. Twelve hours after irradiation mitotic figures again appeared and increased in frequency to above the normal level 18 to 20 hr after irradiation. The increase in mitotic index was found to be caused both by an increase in the cells entering and by a decrease in cells leaving mitosis. The cells entering mitosis 12 or more hr after irradiation appeared to consist of cells that had accumulated in the G_2 period 6 to 12 hr after irradiation and cells coming from the synthetic period that were able to pass through the G_2 period without delay 12 hr after irradiation. Cells entering mitosis 12 or more hr after irradiation were found to spend long periods trying to divide but were most often unsuccessful and, in many cases, they produced a multinuclear giant instead of two normal daughter cells. (auth)

26761 RADIATION EFFECTS ON THE DIVISION CYCLE OF MAMMALIAN CELLS IN VITRO. J. E. Till (Univ. of Toronto and Ontario Cancer Inst., Toronto). Ann. N. Y. Acad. Sci., 95: 911-19(Nov. 13, 1961).

Results are presented that indicate that there is little, if any, specific effect of radiation on the rate of movement of cells through the DNA synthesis period. The evidence bearing on this view is summarized diagrammatically. The duration of mitosis following irradiation was not studied in detail in these cells. Some cells probably fail to enter

mitosis after irradiation, while others may spend an increased length of time in mitosis. Although the duration of the DNA synthesis period is increased by radiation, the increase is not specific, as the duration of the G1 period is also increased to an almost equivalent extent. Thus exposure of mammalian cells to ionizing radiation appears to cause a generalized, dose-dependent increase in the duration of the known stages of the division cycle, with the greatest influence being on the post-DNA synthesis period immediately prior to mitosis. In studying the effects of radiation on the division cycle of mammalian cells, it is necessary to distinguish between specific effects on a particular period such as the DNA synthesis period and general effects on all parts of the cycle. If any specific effect on DNA synthesis does precede the inhibition of mitosis by radiation, it would appear that improved techniques will be required to detect it with certainty in this system. Any pronounced effects of irradiation on DNA synthesis that have been observed in mammalian cells in tissue culture appear to be the result, rather than the cause, of inhibition of mitosis. (auth)

26762 IRRADIATION OF SELECTED PARTS OF SINGLE CELLS. T. R. Munro (Strangeways Research Lab., Cambridge, Eng.). Ann. N. Y. Acad. Sci., 95: 920-31 (Nov. 13, 1961).

Some experiments on the irradiation of parts of dividing chick fibroblasts with alpha particles from polonium-tipped microneedles are described. Chromosomal abnormalities were seen if the chromosomes were irradiated, but not if the radiation was confined to part of the cytoplasm. Other experiments on the irradiation of parts of single cells are reviewed, with emphasis on work with cultured animal cells, and it is concluded that evidence for the belief that the effects of ionizing radiations upon the nuclei, rather than the cytoplasm, are responsible for depriving mammalian cells of reproductive integrity is not yet adequate. A method is described that allows a large fraction of the cytoplasm of single S3 HeLa cells to be irradiated without the nucleus. The cells and their progeny can subsequently be followed for more than one week. (auth)

26763 THE GRASSHOPPER NEUROBLAST CULTURE TECHNIQUE AND ITS VALUE IN RADIOBIOLOGICAL STUDIES. J. Gordon Carlson (Univ. of Tennessee, Knoxville). Ann. N. Y. Acad. Sci., 95: 932-41(Nov. 13, 1961).

A technique is described for the culture of grasshopper neuroblasts in which the neuroblast undergoes successive divisions at a relatively uniform rate through a total of 6 mitotic cycles over a period of 5 to 6 days at 26°C. Even after mitosis ceases, most of the embryonic cells live and undergo differentiation. Results are summarized from studies on the effects of different kinds of radiation on mitosis and on structure and behavior of various parts of the dividing cell. (C.H.)

26764 NUCLEIC ACID METABOLISM AND THE LETHAL EFFECT OF RADIATION ON CULTURED HUMAN CELLS (HeLa). Robert B. Painter (Battelle Memorial Inst., Columbus, Ohio) and Walter L. Hughes. Ann. N. Y. Acad. Sci., 95: 960-8(Nov. 13, 1961).

Results are presented on studies that show that the defect (if any) induced in DNA metabolism by radiation exposure of cells has little or nothing to do with the effects causing mitotic delay and death. Moreover, irradiation does not appear to have any effect on the rate of entry of cells into DNA synthesis and ribonucleic acid metabolism is almost completely unaffected by highly lethal doses of x radiation. (auth)

26765 SOME LIMITATIONS OF LABELED COMPOUNDS IN RADIOBIOLOGICAL INVESTIGATIONS OF DEOXYRIBONUCLEIC ACID (DNA) SYNTHESIS. William B. Looney (Univ. of Virginia, Charlottesville). Ann. N. Y. Acad. Sci., 95: 975-83(Nov. 13, 1961).

The results of recent biophysical and biochemical investigations have demonstrated that careful experimental design is necessary to avoid erroneous or misleading results. The ratio of the specific activity of the labeled compound in the irradiated biological system to the labeled compound in the control is usually interpreted as a measure of the effects of irradiation on a biological process. Since specific activity of DNA is dependent upon the fraction of cells synthesizing DNA and the amount of DNA synthesized per cell per unit of time, information is needed about DNA synthesis within populations of cells. Biochemical studies alone do not provide this information. The rate of synthesis during DNA replication may be exponential. Differences in the time sequence between the irradiated and control populations of cells of synchronous biological systems will give differences in the ratio of the specific activities of labeled compounds. A review of the results reported on the effects of irradiation on DNA synthesis as measured by labeled precursors suggests the following. The finding of two components of the dose-response curve measured with labeled compounds indicates that irradiation affects more than one process involved in the biosynthesis of DNA. Labeled precursors injected during or shortly after irradiation should give results which should more accurately reflect the effects of irradiation on the DNA synthetic process. Relative changes in the rate of synthesis and relative changes in the population of cells in the irradiated and paired control biological systems make quantitative results between the dose delivered and the effects of DNA synthesis unlikely if the labeled precursors are not administered immediately after irradiation. Labeled precursors injected from several hours up to days after irradiation make the results of the effects of irradiation on DNA synthesis difficult or impossible to evaluate. The finding that DNA synthesis is depressed for days after irradiation probably involves the effects of irradiation on cell processes other than DNA synthesis. Depression of the uptake of the labeled precursors is in all probability an indirect effect mediated through disturbances in other cell processes such as mitosis. It is therefore considered that coordinated biophysical studies on individual cells and biochemical studies on total populations of cells offer one of the best approaches to obtain a better understanding of irradiation effects on DNA. Coordinated in vivo and in vitro studies should be more effective than either study made independently in the attempt to gain a better understanding of the biological effects of irradiation. (auth)

26766 MAMMALIAN CELL-CULTURE METHODS IN INVESTIGATING MODIFICATION OF THE RADIATION RESPONSE. Robert Bases (Sloan-Kettering Inst. for Cancer Research, New York). Ann. N. Y. Acad. Sci., 95: 984-93(Nov. 13, 1961).

Single-cell techniques are of great value in studying radiation sterilization. Examples of the use of these techniques in the study of modification of the radiation response are given. (auth)

26767 RNA AS A PROTECTIVE AGENT AGAINST IRRADIATION OF CELL CULTURES. Donald E. Rounds (Pasadena Foundation for Medical Research, Calif.). Ann. N. Y. Acad. Sci., 95: 994-1000(Nov. 13, 1961).

The Fernandes strain of amnion cells, treated with dosages ranging from 0.01 to 0.5 mg/ml of yeast RNA 24 hours

prior to 700 r gamma radiation, showed increased survival as compared with control cultures not so treated. Approximately 3 times as many cells survived 700 r when pretreated with 0.2 mg/ml yeast RNA. A minimum RNA treatment time of 8 to 10 hr was necessary before a protective response could be elicited in irradiated amnion cells. Thus protection may result only after the yeast RNA is utilized by the cell. RNA-treated and control cultures of amnion cells were exposed to gamma doses ranging from 0 to 700 r. Survival was represented by parallel lines on a semilogarithmic plot, which suggested a possible increase in the cell number of treated cultures prior to the onset of radiation damage. Daily counts of amnion cells indicated that RNA-treated elements multiply at a normal rate for 2 days postirradiation, whereas untreated irradiated cultures showed an immediate inhibition in the rate of growth. Seven different established cell strains exhibited variations in the response of preirradiation treatment with yeast RNA. Four cell types of nonmalignant origin showed from 0.5 to 8 times more cells surviving 700 r when pretreated with RNA than untreated, irradiated cultures. Three cell lines of malignant origin showed no evidence of protection. (auth)

26768 QUANTITATIVE STUDIES OF RADIATION EFFECTS ON CELL REPRODUCTIVE CAPACITY IN A MAMMALIAN TRANSPLANTABLE TUMOR SYSTEM IN VIVO. Roger J. Berry and J. Robert Andrews (National Cancer Inst., Bethesda, Md.). Ann. N. Y. Acad. Sci., 95: 1001-8 (Nov. 13, 1961).

The transplantability of leukemic ascites cells from mice bearing the transplanted lymphocytic leukemia P-388 was utilized as a measure of cell reproductive capacity. The response of mammalian cells to ionizing radiation appears to be similar in vivo and in vitro. The system is relatively free of host-immunity factors and has been used to study the effects of oxygenation and anoxia, the effects of dose fractionation and aspects of cellular recovery, and changes in radiation response induced by pharmacological agents. (auth)

26769 FIBROSIS AND COLLAGEN IN RATS LUNGS PRODUCED BY RADIOACTIVE MINE DUST. F. M. Engelbrecht, B. F. Thiart, and A. Classens. Ann. Occupational Hyg., 2: 257-66(Nov. 1960).

Rats were injected intratracheally with mine dust samples (50 mg/rat) of which the silica content ranged from 66-86% and which also showed different degrees of radioactivity. The samples all had more or less similar size distributions. Histological changes were followed, up to 370 days, with the degree of fibrosis assessed. Chemical determinations of collagen, phosphate, and silica content of tissue were done and the wet weight of lymph glands determined. The samples showed a wide range of fibrogenic activity. Samples with a relatively high radioactivity and low silica content produced significantly more collagen than those with a high silica content and a low or negative radioactivity. No correlation was found between the amounts of silica retained and the amounts of collagen in the lungs of the animals. The weight increases of lymph glands varied for different samples but the variations were not as large as with the rates of collagen production. There was a good correlation between the amounts of collagen produced in the lungs and the weight increases of the lymph nodes, as well as between the amounts of collagen and the total phosphate content of the lungs in the dust groups. APCA abstr., 8: no. 2, 1962.

26770 EXPERIMENTAL RADIOBIOLOGY OF TUMORS. RECENT KNOWLEDGE ON RADIOSENSITIVITY. S. Abbatucci, J. Jacquet, and P. Jacob. Ann. radiol., 5: 379-94 (1962). (In French)

A bibliographic survey is made of recent data obtained on the radiobiology of tumors. The topics discussed include the mode of application and quality of radiation, radiosensitivity factors in experimental tumors, acquired radioresistance, and effect of irradiation of the tumor on the frequency of metastases. (J.S.R.)

26771 FIRST RESULTS ON X-RAY-INDUCED GENETIC DAMAGE IN ARTEMIA SALINA LEACH. P. Metalli and E. Ballardin (Università, Milan). Atti assoc. genet. ital., 7: 219-31(1962). (In English)

Prophase oocytes of diploid and tetraploid partenogenetic Artemia salina were x irradiated with 1000 r and damage was scored as oocyte or embryo lethal mutations at the first (X_1) and at the second (X_2) generations after irradiation. Dominant lethality shown at X_1 was much greater for the diploid strain than for the tetraploid; lethality observed at X_2 was increased with respect to X_1 in the diploid strain, while in the tetraploid it remained unmodified. (auth)

26772 A UNIQUE MODE OF ACTION OF ULTRAVIOLET IRRADIATION IN PROPHAGE INDUCTION. Ann M. Ryan (Columbia Univ., New York). Biochim. et Biophys. Acta, 60: 455-7(July 2, 1962). (In English)

Experiments were conducted to see whether the cross-inducing effect of uv irradiation in bacterial conjugation can be superimposed on induction by other agents. Male lysogenic E. coli was subjected first to x radiation or mitomycin C and then to uv radiation before admixture with a female E. coli population (F^-) for determining whether the inductive effect was transferred to the female population. The results show that x radiation or mitomycin C alone produced no transfer, but in combination with uv gave a cross-induction transfer. It is concluded that damage in lysogenic bacteria occurs at different sites in x-ray and uv induction, although phase production results in both cases. (D.L.C.)

26773 SELF-ABSORPTION CORRECTION FOR ^{14}C-β-RADIATION AT WIDE-ANGLE GEOMETRY. E. O. Arvidsson (Univ. of Lund, Sweden). Biochim. et Biophys. Acta, 60: 590-4(July 16, 1962). (In English)

Most procedures used for self-absorption correction cannot be applied to wide-angle counters. A method for obtaining a self-absorption coefficient, which includes self- and back scattering, for C^{14}-organic material and 2π geometry is presented and discussed. A simple correction procedure is given. (auth)

26774 THE RELATIONSHIP BETWEEN THE FRACTION SURVIVING TEST SUBJECTS AND THE OXYGEN CONCENTRATION IN EXPERIMENTS WITH IONIZING RADIATIONS. A. A. van Soestbergen (National Defence Research Organization T.N.O., Rijswijk, Z. H., Netherlands). Biochim. et Biophys. Acta, 60: 653-5(July 16, 1962). (In English)

The statistical analysis of radiobiological data is discussed from the standpoint of the relationship between the fraction of surviving test subjects and the oxygen concentration. It is pointed out that at a given radiation dose there is a variation in the response of the subjects and that a fraction responds even in the absence of oxygen. A method is presented for calculating the fraction of test subjects surviving the oxygen effect alone. The effects of previously administered radiation on radiosensitivity are also considered. Data are included from experiments on the effects of oxygen on radiosensitivity of Serratia marcescens. (C.H.)

26775 PHENOTYPIC AND GENOTYPIC CHARACTERIZATION OF RADIATION SENSITIVITY IN ESCHERICHIA COLI B. A. Roersch, A. Edelman, C. Van der Kamp, and

J. A. Cohen (National Defence Research Organization TNO, Rijswijk, Netherlands). Biochim. et Biophys. Acta, 61: 278-89(Aug. 20, 1962). (In English)

From the wild type Echerichia coli B a radioresistant and a radiosensitive mutant were isolated. Ultraviolet light survival curves for the newly isolated strains resemble those given for E. coli B/r and E. coli B_s respectively. It was proved by biochemical methods that the differences among the three strains are due to two independent mutations, one leading to loss of the tendency to form filaments after various treatments and the other leading to a strong inhibition of growth, nucleic acid, and protein synthesis after irradiation with ultraviolet light. X-ray, ultraviolet light, P decay, and nitrous acid survival curves for the strains are presented. Moreover, survival curves are given for a fourth strain which bears both independent mutations. Procedures are described for screening large numbers of strains arising from conjugation experiments for both types of mutation. Conjugation experiments between F^+ and F^- auxotrophic mutants were performed. These suggest that both mutations are chromosomally determined. (auth)

26776 EFFECT OF IRRADIATION ON SOME ASPECTS OF TISSUE IMMUNITY. Reuben L. Kahn (Univ. of Michigan, Ann Arbor). Bol. inst. bacteriol. Chile, 11: 58-9 (1959).

Results from a series of studies indicate a decrease in inflammatory reaction associated with both whole-body and local radiation exposure. Inflammation was induced in rabbits by the injection of diphtheria antitoxin, staphylococci, or horse serum. (C.H.)

26777 CINEMATOGRAPHIC OBSERVATION OF THE GROWTH IN VITRO OF EMBRYONAL LUNG OF THE RAT IN NORMAL CONDITIONS AND WITH IRRADIATION BY GAMMA RAYS. Tommaso Alescio and Mario Ladu (Comitato Nazionale per l'Energia Nucleare, Rome). Boll. zool., 28: 247-52(1961). (RT/B10(62)6). (In Italian)

A study was made of the development in vitro of embryonic mouse lung, by means of time-lapse cinematography, in normal conditions and after gamma-ray irradiation. The growth and branching of the buds already formed at explanation time and the formation of new buds and of tertiary branches are described. In irradiated lung anlagen the bronchial tree is invaded by opaque material derived from degenerated cells of the bronchial epithelium. Later the opaque material gradually disappears and the lung anlagen show their previous transparency again. Contraction movements of parts of the bronchial tree contribute to this process. The ramification process in irradiated lungs is strongly slowed down. (auth)

26778 A REVERSELY RESPONSIVE VARIANT OF A THYROTROPIC TUMOR WITH GONADOTROPIC ACTIVITY. Bernard Messier and Jacob Furth (Francis Delafield Hospital, New York; Columbia Univ., New York; and Roswell Park Memorial Inst., Buffalo). Cancer Research, 22: 804-8(Aug. 1962).

An autonomous thyrotropic pituitary tumor (Strain 82) was induced in a female mouse by head-neck irradiation with 550 r. In the course of the third successive passage in intact mice, the tumor cells not only lost the property of being inhibited by TH but actually became markedly stimulated by it. The reversal of the growth pattern was accompanied by loss of thyrotropic property while the gonadotropic potency of the original tumor cell was maintained. The gonadotropic effect is evident in athyroid hosts, but is rarely seen in intact hosts. (auth)

26779 HEAD IRRADIATION OF THE BURRO WITH COBALT-60. U. S. G. Kuhn, III (Warren Air Force Base, Wyo.) and Daniel G. Brown. Clin. Sci., 180: 671-5(May 1962).

The response of burros to gamma irradiation of the head from Co^{60} was characterized by the rapid onset of symptoms suggestive of brain damage, hyperglycemia, and early mortality. Death followed respiratory paralysis. Pathological changes in the brain included subarachnoid hemorrhage, perivascular, cuffing, extravasation of plasmatic fluid, neuronophagia, and early satellitosis. The relationship of survival time to dose rate is discussed. (auth)

26780 REACTION OF LIVER RIBONUCLEIC ACID WITH FORMALDEHYDE BEFORE AND AFTER X-IRRADIATION IN VIVO. S. Zadražil and Z. Šormová (Inst. of Organic Chemistry and Biochemistry, Czechoslovak Academy of Science, Prague). Collection Czechoslov. Chem. Communs., 27: 1292-9(May 1962). (In English)

Making use of the reaction of formaldehyde with free amino groups of total, microsomal, and soluble RNA from rat liver, were subjected to an investigation of changes in their secondary structure formed by irradiation in vivo with x rays or by heat denaturation of isolated preparations of RNA. The secondary structure of these preparations, with the exception of the highly resistant s-RNA, is affected by irradiation, bringing about severing of hydrogen bonds which stabilize the spiral sections of the RNA molecule as is reflected in an increase of the reaction of free amino groups of RNA with formaldehyde. Results obtained with heat denaturation of RNA carried out in the same manner point to the stability of the secondary structure of the RNA studied at 37° and to the formation of a monofibrous random structure of RNA when denatured. (auth)

26781 THE EFFECT OF IONIZING RADIATION ON TOTAL, MICROSOMAL AND SOLUBLE RIBONUCLEIC ACID OF RAT LIVER. S. Zadražil and Z. Šormová (Inst. of Organic Chemistry and Biochemistry, Czechoslovak Academy of Science, Prague). Collection Czechoslov. Chem. Communs., 27: 1299-1309(May 1962). (In English)

Enzymic digestion of RNA preparations isolated from rat tissue 4 hr after irradiation was used to investigate in vivo the effect of x irradiation on the RNA of different fractions of liver cells. The irradiated tissue was found to contain a lower amount of total and m-RNA while the isolable amount of s-RNA was not affected by the irradiation. The qualitative composition of enzymic hydrolyzates of all RNA fractions was the same. With total RNA and m-RNA quantitative differences were found in fractions adenylic, guanylic, cytidylic, uridylic, and pseudouridylic acids and their residues which occur in greater amounts in the hydrolyzates of these types of RNA from organs of irradiated animals. As these quantitative differences could not be found in s-RNA preparations, it appears that the x irradiation affects first of all the structure of high-molecular RNA of cellular particles while the s-RNA is not attacked. The present paper contains a discussion of the possible mode of interference of irradiation with the primary and secondary structure of the RNA polynucleotide strand. (auth)

26782 ACTION OF TWO SUCCESSIVE APPLICATIONS OF X RAYS ON THE DEVELOPMENT OF TISSUES OF SALSIFY CROWN-GALL CULTIVATED IN VITRO. Robert Jonard. Compt. rend., 254: 3121-3(Apr. 25, 1962). (In French)

The radiosensitivity of the tissues increased by one application of x rays; this augmentation is shown by the fact that a second application causes a more marked inhibition of the proliferation than that caused by the first irradiation. (tr-auth)

26783 IMIDAZOLE AND SOME OF ITS DERIVATIVES IN CHEMICAL RADIOPROTECTION. Renaud Rinaldi and

Yvette Bernard (Centre d'Etudes Nucléaires, Grenoble, France). Compt. rend., 254: 4217-19(June 13, 1962). (In French)

The radioprotective properties of imidazole and seven of its derivatives were studied, and the effects of different treatment conditions were evaluated. Mice, aged 12 to 18 weeks, were exposed to lethal x-ray doses immediately after injection of the imidazole or its derivatives. The efficiency of the drugs was determined from the survival rate. The results showed that only imidazole offered any significant radioprotection. The effects of time between injection and irradiation, of dose injected, and of radiation dose on the efficiency of the imidazole were also briefly studied. (J.S.R.)

26784 STUDY OF THE CELLULAR MODIFICATIONS OF THE HEMATOGENIC MARROW OF THE GUINEA PIG AFTER IRRADIATION. C. Bimes, A. Guilhem, J. F. David, and C. Garson (Universite, Toulouse). Compt. rend. soc. biol., 156: 511-15(1962). (In French)

It is reported that the mononuclear lymphocytic figures appearing in large number in the hematogenic marrow of the guinea pig after irradiation are, to an important extent, root cells which are not lymphocytics: the administration of cortisone does not cause lysis and does not impede medullary regeneration. In addition a non-specific esterase activity is detected in their cytoplasms, which argues in favor of their reticulohistiocytary nature. (tr-auth)

26785 VIABILITY OF THE FIRST GENERATION OF HYBRIDS FROM IRRADIATED MICE C57 BL AND DBA. Robert D. Boche, D. J. Méwissen, John H. Rust, and Ann M. Budy (Universite Libre, Brussels and Univ. of Chicago). Compt. rend. soc. biol., 156: 532-35(1962). (In French)

DBA and C 57 Black subline 6 mice, male and female, were separated into couples and either the male or female were irradiated, with the irradiated mice being in all cases of the C 57 Black race. The mortality in the first generation after the irradiation of one parent was established, and the results are tabulated. The results suggest that the viability of C 57 Bl × DBA conceived no later than ten days after the irradiation of the father is significantly reduced. The irradiation of the mother, however, appears to have no effect. (J.S.R.)

26786 THE EFFECTS OF X-RAYS ON THE RECOMBINATION OF LINKED CHARACTERS IN THE TOMATO. Donald Kenneth Ourecky (Washington State Univ., Seattle). Dissertation Abstr., 22: 960-1(Oct. 1961).

A study was made to determine if x rays would increase the frequency of recombination of characters in the tomato and therefore provide a practical and economic method to be used in tomato breeding. Five linked genes located in chromosome 2 were selected for study namely, d (dwarf plant height vs tall plant height D); p (pubescent fruit vs smooth fruit P); o (ovate-fruit shape vs round fruit shape O); s (compound inflorescence vs simple inflorescence S); and bk (non-beaked fruit vs beaked fruit Bk). The Sioux variety and a recessive selection were used as parents. F_1 plants were grown in flower pots, in which the first flower trusses were irradiated with x rays to doses up to 1500 r, at three stages of flower bud development. A backcross population of 100 plants was grown from each stage and treatment. Irradiation significantly reduced the percentage of normal pollen grains. As the irradiation treatment increased the number of normal pollen grains decreased from 100.0% in the check treatment to 77.5% in the 1500-r treatment. Irradiation did not affect the seed germination percentage nor the length of time required for the backcross seed to germinate. No significant differences were observed in the irradiation treatments as to the number of chiasmata formed in chromosome 2. An average of 2.2 chiasmata was observed for all treatments and stages. The results indicated that x-ray doses of 500 to 1500 r, when applied to an inflorescence, did not affect the recombination values for the five linked genes. The average observed recombination values for the d-p, p-o, o-s, and s-bk regions were 2.6, 7.4, 18.1, and 1.3 respectively. Backcross ratios were obtained that showed a marked reduction in the number of recessive parental genotypes recovered when compared to the number expected. Among the recombination genotypes, the frequencies of those containing the s gene were reduced in comparison to their corresponding recombination class. A tentative hypothesis involving a small inversion in the s-bk region was proposed. Therefore, an increase in the frequency of certain three-strand double crossover combinations, between the centromere and the inversion loop, could explain the over-all reduction in recombination frequency, the unexpected monogenic ratios, and the extreme reduction in recombination for the s-bk region.

26787 PHYSIOLOGICAL STUDIES ON RADIATION RESISTANT BACTERIA OCCURRING IN FOOD. Dennis Edward Duggan (Oregon State Univ., Eugene). Dissertation Abstr., 22: 973-4(Oct. 1961).

Spoiled samples of radiation-sterilized ground beef are found to contain large numbers of non-sporing forms of bacteria, which are found to be remarkably resistant to radiation. These organisms are described and classified and their resistance to gamma radiation, ultraviolet light, and heat are characterized. Three cultures of a micrococcus and one of a rod culture are described. All four cultures are non-motile, non-sporing, non-encapsulated, aerobic Gram-positive organisms forming pink to red colonies. The cocci are typically found in tetrads, while the rods appear as single cells or in chains. The morphology, cultural characteristics, biochemical reactions, and physiological characteristics of the organisms are described. The cultures do not closely resemble previously described species. The names proposed are: for the coccus, Micrococcus radiodurans Anderson Nov. Spec.; and for the rod, Brevibacterium oregonium Anderson Nov. Spec. Raw pureed meat substrates are developed that can be pipetted for quantitative bacteriological studies. Using these methods, gamma radiation survival curves are determined in raw beef using four strains of Micrococcus radiodurans and one culture of Brevibacterium oregonium. The rod culture is as resistant as the most resistant strain of the coccus cultures. Survival curves in raw and cooked beef, raw chicken, raw fish, and buffer are determined. The effects of growth medium and of initial cell concentration are investigated. All cultures exhibit segmoidal survival curves in all menstrua used. Terms are developed to describe the survival curves under various experimental conditions. The most resistant cultures are reduced in number by a factor of about 10^{-5} by 3.0 megarad, 10^{-9} by 4.0 megarad, and 10^{-12} by 4.7 megarad. Higher menstruum temperatures during radiation and preirradiation heat treatments lower resistance to irradiation. Irradiation in a frozen menstruum offers only slight protection. The effects on resistance of various modifying factors in a buffer substrate are described. Ascorbate seems to greatly enhance radiation destruction. The gamma-resistant micrococcus is shown to be more resistant to ultraviolet light (UVL) than other nonsporing bacteria or spores of Bacillus globigii. Some similarities and differences in response to UVL and gamma radiation are pointed out. The effects on resistance to UVL

of various menstruum factors were described. Photoreactivation is not demonstrated. The thermal resistance of the most gamma-resistant coccus culture is characterized by Decimal-reduction-time (D values) and z-values. Thermal death, unlike radiation inactivation, seems to approximate an exponential rate. A $D_{140} = 0.75$ and $z = 10.65$ describe the heat resistance in beef.

26788 A STUDY OF THE EFFECTS OF X-IRRADIATION ON THE SPINAL CORDS OF NEONATAL RATS. Shirley Ann Gilmore (Univ. of Cincinnati). Dissertation Abstr., 22: 2939(Mar. 1962).

A study is made of neurological and histological changes resulting from x irradiation of spinal cords of neonatal albino rats of the Sprague-Dawley (Holtzmann) strain. Rats, one to 21 days of age, receive radiation to a 50 mm^2 area on the dorsum of the body overlying the spinal cord under the following conditions: 50 KVP; 5 ma; single dose; total dose, 4430r; dose rate, 670 to 720r/minute; FSD, 8.5 cm; inherent filtration equivalent to 0.1 mm aluminum; added filtration, 0.25 mm aluminum; HVL, 0.16 mm aluminum. These animals are given neurological examinations for several months. Neurological alterations ranging from slight ataxia to complete bilateral paralysis are observed. Permanent neurological changes occur in more than 70.0% of those surviving after irradiation at 1 to 3 days of age. The percentage gradually decreases to 16.6% in the group irradiated at 15 days of age; no neurological abnormalities are noted in those irradiated on day 21. The interval between time of irradiation and onset of neurological alterations increases as the age at the time of irradiation increases. The latent period is 9 to 11 days for those irradiated at 1 to 6 days of age, 17 to 20 days for those irradiated on day 10 and 28 to 32 days for those irradiated at 15 days of age. All groups contain animals that remain apparently normal throughout the experimental period. Animals that recover from neurological alterations are also observed in the groups irradiated at 5 days of age or later. This recovery rate is as high as 50.0% in the 6 and the 15 day groups and occurs in animals with complete bilateral paralysis as well as animals only slightly afflicted. By two months post-irradiation marked deformation of the vertebrae in the irradiated areas is noted. In an attempt to determine the causes of the neurological alterations, animals are irradiated at three days of age in the manner described. These are sacrificed at intervals up to and including the time of onset of neurological changes (9 to 11 days after irradiation). The spinal cords are fixed and interrupted serial sections are prepared for study; cresyl echt violet, hematoxylin and eosin, and myelin strains were used. Striking and consistent histological changes are observed in neuroglia and myelin. As early as two days after irradiation a marked decrease in the number of neuroglia is noted in all irradiated areas, whereas above and below the lesions the sections appear to be essentially normal. The decrease persists throughout the experimental period and, although a quantitative study is not conducted, oligodendroglia appear more severely affected than astrocytes. Myelin does not develop normally in any of the areas showing a diminution of glia. The unmyelinated or lightly myelinated areas are confined to the site of irradiation and, in striking constrast, immediately adjacent areas and spinal roots including those within the lesion show a normal amount of myelin. Extensive degeneration of neurons is not observed. The neurons appear to mature normally since in later stages of the experiment ventral horn cells show adult, multipolar configurations with discrete clumps of Nissl substance in the cytoplasm. Vascular alterations, manifested only as petechial hemorrhages and endothelial swelling, are noted most frequently at 9 to 11 days post-irradiation.

26789 THE EFFECTS OF X RAY INDUCED EUPLOID AND NEAR-EUPLOID MUTANTS IN HETEROZYGOUS CONDITION UPON DEVELOPMENTAL STAGES OF DROSOPHILA MELANOGASTER. Robert Cahill Baumiller (St. Louis Univ.). Dissertation Abstr., 22: 2950-1(Mar. 1962).

Euploid and near-euploid mutants in heterozygous condition, induced by 3000r of x rays, were studied for their effects on various developmental stages of Drosophila melanogaster. This study required the development of techniques by which the duration of the egg and larval stages as well as the ability of larvae to pupate could be employed as criteria for detecting these heterozygous effects. In interstrain crosses these mutants were found to produce delay in pupation in about 9% of larvae under nutritional stress, and the killing of approximately 6%. The effect was less, about 7% delayed and 5% killed, when there was excess nutrient. Irradiation of sperm or oöcytes caused approximately equal amounts of detriment, doubtless partly by different types of mutation; no effect of delay or death in the larval stage was detected when oögonia were irradiated. In interstrain crosses about 5% of all hatching larvae were delayed in the egg stage by the mutants produced by x-raying P_1 males who were mated to sibling females. Of larvae not delayed in the egg stage, about 10% were delayed in the larval stage, of which 70% were killed. Of all larvae hatching, about 15% showed an effect in either the egg or the larval stage, while 1.4% were affected in both stages. After males from stocks containing heavier than normal genetic loads were irradiated, a greater than additive effect of heterozygous mutants was noted upon egg hatching. Thus, newly induced heterozygous mutants produced about 15% of effect when added to the heavier genetic load, but produced only about one-fourth this effect when added to the smaller (normal) load. The detrimental effects of euploid or near-euploid mutants in heterozygous condition detected were quite large. No evidence was found in support of the balance hypothesis of heterozygote advantage. However, all the results obtained could be explained by the classical hypothesis.

26790 THE EFFECT OF X-IRRADIATION ON EMBRYONIC HEMATOPOIETIC TISSUES. Lewis Kelty Wayt (Univ. of Colorado, Boulder). Dissertation Abstr., 22: 3161-2 (Mar. 1962).

A total of 581 guinea pig embryos were used to investigate the effect of x rays on developing hematopoietic tissues. The irradiated embryos were divided into 7 age groups, from 13 to 50 days. The doses of x rays ranged from 27 to 400 r. Each pregnant female was anesthetized with sodium pentobarbital and a laparotomy was performed. The embryos in one uterine horn were irradiated once. The embryos in the opposite uterine horn served as non-irradiated controls. After irradiation, all embryos were sacrificed and the hematopoietic tissues (yolk sac, liver, spleen, thymus, bone marrow, and lymph gland) were studied. A comparison was made between the tissues of the irradiated embryos, non-irradiated control embryos, and unoperated-control embryos. Hematopoiesis in the yolk sac of irradiated embryos did not differ from that in the control embryos regardless of the age at the time of irradiation. Also, differences in hematopoiesis in the liver, spleen, and thymus were not found between control embryos and 13-day embryos irradiated with 27, 52, or 78 r, or 15-day embryos irradiated with 50 r, or 16-day embryos irradiated with 100 r. Mild to severe fibrosis of the spleen was found in young animals irradiated with 250 or 300 r as 27-day em-

bryos, and sacrificed at 11, 27, and 28 months after irradiation. The lymphocytes of the thymus were the most sensitive hematopoietic cells studied. The amount of necrosis varied with the age, the number of lymphocytes, and the dose. The lymphocytes showed severe karyorrhexis soon after irradiation, but repopulation was complete within 5 days. This repopulation was followed by hemorrhage, liquefaction necrosis, and degeneration by 7 to 10 days after irradiation. The response of blood cell precursors in the liver was generally the same as in the spleen. After irradiation, the hematopoietic cells in these organs, with exception of megakaryocytes, showed moderate karyorrhexis. Focal erythropoiesis then developed within 2 to 5 days. Myelocytes and megakaryocytes generally disappeared within 5 days after irradiation. The lymphocytes in the spleen disappeared following irradiation and then regenerated, but their concentration never equaled that in the control spleen. In the bone marrow, the hematopoietic cells, with the exception of megakaryocytes, showed severe karyorrhexis after irradiation. Cellular regeneration was generally poor and consisted mostly of erythroblasts. Megakaryocytes never regenerated, and only a few myelocytes were present during the latter part of the 10 day post-radiation period. The lymphocytes in the lymph glands showed only a slight amount of karyorrhexis after the administration of x rays. Regeneration of these cells was better in fully developed lymph glands than in newly formed lymph glands. The mesenchymal cells of all hematopoietic tissues were more radioresistant than were the blood cell precursors. However, an indirect effect was shown in that the progeny of these mesenchymal cells had little or no ability to give rise to more mature cells. In most respects, the effect of irradiation on the embryonic hematopoietic tissues and cells was similar to that described in post-natal hematopoietic tissues and cells.

26791 MEIOSIS, MITOSIS, AND THE INDUCTION OF CHROMOSOMAL ABNORMALITIES IN HYMENOLEPIS DIMINUTA BY GAMMA RAYS. Raymond Louis Kisner (Univ. of Tennessee, Knoxville). Dissertation Abstr., 22: 3304 (Mar. 1962).

Chromosomes of the adult stage of the cestode Hymenolepis diminuta are studied in aceto-orcein squashes of selected portions of the strobila. The details of oögenesis are observed and recorded; they are very similar to those for other organisms. Oögonia increase in size and pass to the uterus where meiosis occurs. A small cell of unknown origin and function attaches itself to the primary oöcyte. Reduction divisions proceed in a typical manner. Penetration of the oöcyte by the sperm occurs prior to metaphase I. Male and female pronuclei do not fuse with each other, but remain separate during prophase. Their chromosomes mingle on the first cleavage spindle at metaphase. The cleavage pattern during the first six embryonic divisions is determined. The first five cleavage divisions of the embryo are unequal. The zygote appears to be subdivided by the "cutting" off of small cells from the main mass during these five divisions. An equal division occurs for the first time at cleavage VI and involves the largest cell of the embryo, as do the first five. The small cells formed during the early cleavages are of different sizes, depending upon the number of the division. The smaller cell formed by cleavage I is larger than those produced by the next three cell divisions of the embryo. There are twelve acrocentric chromosomes in metaphase plates. Chromosomes are of maximum size during the first few cleavage divisions, but become smaller as the large cell is reduced in size by the mitotic subdivision. The mitotic process is very precise with few, if any, irregularities in thousands of divisions. Mature worms are irradiated with gamma rays (400, 800, 1200, and 5000 r) by whole-body irradiation of rat hosts. Fixation times are 2, 7, 8, and 24 hours after the end of the irradiation period. As the dose of radiation increases, the number of embryos with aberrations also increases. "Sticky" chromosomes are found in worms examined soon after irradiation. Fragments and bridges appear in all material observed. Variations of chromosome number are noted. Chromosomes exceeding normal length are seen in a few cells. Moderately long ones are probably a result of translocations. The extremely long chromosomes suggest a chromatid breakage-fusion-bridge cycle. A sample count of aberrations in the first five cleavage divisions are made in three worms receiving 5000 r. There are 451 embryos with chromosome alterations in 990 observed, or 45.5 per cent of the total. A greater percentage of these are found in cleavages III through V than are observed in the first two divisions. A growth rate study for H. diminuta in ten worm infestations is attempted for possible use in determining the number of cleavage divisions per given length of worm. The desired number of worms are not recovered from enough rats to establish a reliable growth curve.

26792 THE HARMFUL EFFECT OF Sr^{90}–Y^{90} ON THE EARLY DEVELOPMENT PERIOD OF MULLUS BARBATUS PONTICUS, THE HYBRID CRENILABRUS TINCA X C. QUINQUEMACULATUS, TRACHURUS AND ENGRAULIS ENCRASICHOLUS. G. G. Polikarpov and V. N. Ivanov (A. O. Kovalevskii Sevastopol Biological Station, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 219-22(May 1, 1962). (In Russian)

Standard solutions of sea water containing 10^{-6}, 10^{-8}, 10^{-10}, 10^{-12}, and 10^{-14} curies of Sr^{90} per liter were prepared. Fish eggs were placed in the radioactive solutions shortly after hatching, and the eggs were developed at 20 to 24°C. It was established that the yield of anomalous young fish was a more sensitive index of radiation damage than the number of dead fish eggs. An anomaly of the vertebra was the most frequent type of anomaly. Analogous anomalies were also observed on irradiating the fish eggs externally with a small dose of γ rays over a long period of time. The fraction of anomalous young fish observed was a linear function of the dose of Sr^{90}. Radiation damage began at 10^{-10} curies/liter which was equivalent to a dose of 10^{-1} rad/day [0.1 of natural background]. The damage was due to the accumulation of Y^{90} in the organism, and not the Sr^{90} itself which did not accumulate in the young fish. It was concluded that fish eggs are very radiosensitive and that disposal of radioactive wastes to the ocean should be curtailed. (TTT)

26793 AN ELECTRON MICROSCOPE STUDY ON THE HEALING OF A RAT LIVER AFTER LOCAL X-RAY IRRADIATION. M. M. Kalashnikova (A. N. Severtsov Inst. of Animal Morphology, USSR). Doklady Akad. Nauk S.S.S.R., 144: 918-21(June 1, 1962). (In Russian)

White rats 160 to 180 grams in weight were given a single x-ray dose of 1000 r to the region of the liver. One week after irradiation, a wound 6 mm in diameter was made on the right side of the right lateral section of the liver. Rats operated on in the same way but not irradiated served as controls. Four days after the operation the rats were killed by decapitation, and the liver was fixed in a Zenker solution for histological treatment, and also in a buffered solution of osmium tetroxide at a pH of 7.2 for observation on a UEM-100 electron microscope. A description of the various cells found in the parenchyme of the liver is presented. An emigration of leucocytes to the

damaged zone, and an intensification in the proliferation process was noted in the control rats on the 4th day after the operation. In the irradiated rats vacuoles were frequently detected in the cytoplasma, and also a large number of drops of fat which indicate fatty infiltration of the liver. The proliferation of tissue was much weaker. Damage to mitochondria near veins or arteries is frequently observed, and this damage is related to the tendency to bleed which is one of the common symptoms of radiation injury. (TTT)

26794 THE ROLE OF PROTEINS AND OF THE NUCLEIC ACIDS IN RESTORING THE REGENERATIVE CAPACITY OF THE EXTREMITIES IN SALAMANDERS (AXOLOTLS), WHICH HAD BEEN SUPPRESSED BY X-RAY IRRADIATION. L. V. Polezhaev, N. A. Teplits, and S. Ya. Tuchkova (A. N. Severtsov Inst. of Animal Morphology, USSR). Doklady Akad, Nauk S.S.S.R., 144: 930-3(June 1, 1962). (In Russian)

White and black salamanders 8 to 10 months old were given an x-ray dose of 10,000 r to the extremities, or a whole body dose of 1000 r. Both feet were then amputated 17 to 19 days after the local irradiation. The salamanders were injected once a day for six days with 3 mg of RNA, 2 mg DNA, 110 mg of liver protein, or 10 mg of acid protein from milk. In the experiments with local irradiation of the extremities the following series of experiments were performed with 10 salamanders per series: controls with simple irradiation and amputation: irradiation, amputation and treatment with RNA; the same treatment with DNA; the same treatment with acid milk protein; the same treatment with liver protein; the same treatment with RNA and liver protein; the same treatment with RNA and acid protein; treatment with RNA, and irradiation and amputation two months later; irradiation, treatment with liver protein, and amputation two months later; and irradiation, treatment with RNA, and amputation two months later. The extremities grew back on the salamanders in 5% of the cases for the controls, in 33% of the cases after treatment with RNA, in 22% of the cases after treatment with acid milk protein and in 12.5% of the cases after treatment with liver protein. On repeating the amputation of the extremity, treatment with RNA was especially effective in bringing about the growth of new limbs (90 to 100% of the cases). Biochemical analysis showed that the content of RNA in the irradiated limb fell from a normal of 400 γ to 130 γ per 100 mg of dry material, and the RNA content rises sharply when new limb growth takes place. (TTT)

26795 A RADIATION STUDY OF THE FUNCTION OF OOCYTES IN THE PROCESS OF OVULATION IN THE LOACH. A. A. Neifakh and I. M. Shapiro (A. N. Severtsov Inst. of Animal Morphology, USSR). Doklady Akad. Nauk. S.S.S.R., 144: 942-4(June 1, 1962). (In Russian)

There is evidence to suggest that a maternal genotype determines the type of early development in the early stages of ovogenesis in fishes. It is thought that the nucleic material, controlling development of the fetus up to the gastrulation stage, is formed during ovulation. In order to test this hypothesis, ovulation was induced in female loaches by hormone injection, and then the fish were given an x-ray dose of 60,000 r immediately after injection of the hormone, and 12, 24, and 40 hours after injection, that is, before the production of full-grown eggs. The fish were irradiated in pairs. The ripe eggs of series I were inoculated with normal sperm, and those of series II with sperm which had been given a dose of 40,000 r. Eggs from unirradiated fish and innoculated with unirradiated sperm served as controls. The fertilized eggs of series I developed normally up to the gastrulation stage, whereupon death occurred due to haploid development. Hence, irradiation does not hinder the normal development of the egg in the early stages of ovogenesis. The high radiation dose of 60,000 r was sufficient to completely inactivate the egg. (TTT)

26796 EFFECT OF ROENTGEN RADIATION ON THE PHYSICOCHEMICAL AND BIOCHEMICAL PROPERTIES OF HEMOGLOBIN IN RADIATION SICKNESS OF ANIMALS. B. F. Sukhomlinov and V. V. Merenov. Dopovidi Akad. Nauk Ukr. R.S.R., No. 5, 624-7(1962). (In Ukrainian)

Data are presented on experimental studies of the electrophoretic mobility of hemoglobin (Hb) in agar gel, its amino-acid composition, the process of dissociation, and the absorption curves of oxyhemoglobin (HbO_2) of dogs subjected to x irradiation in doses of 600–700 r. It is shown that soon after irradiation Hb migration in the electric field changed in dependence on the development and course of radiation sickness. The rate of Hb migration at the same times reflects the phase character of radiation sickness. Irradiation of animals does not exert a substantial effect on the nature of the HbO_2 absorption curves. In irradiated dogs the quantity of sulfur-containing amino acids in the Hb hydrolysate was found to be considerably lower, and in some tests it was not detected altogether chromatically. A study of the process of HbO_2 dissociation in the erythrocyte suspension indicates a functional disturbance of Hb. Thus, during radiation sickness in dogs, the physicochemical and biological properties of Hb are altered, which places the radiation syndrome among the pathological processes connected with the molecular pathology of hemoglobin. (auth)

26797 SOME PROBLEMS IN THE CULTURING AND RADIATION SENSITIVITY OF NORMAL HUMAN CELLS. Grace Norris and S. L. Hood (Charles F. Kettering Foundation, Yellow Springs, Ohio). Exptl. Cell Research, 27: 48-62 (June 1962).

Cells of normal human kidney, lung, and skin tissues were cultured for several months in media containing either fetal calf or human plus horse sera. Fibroblastic cells became predominant in all cultures. In kidney cultures epithelial-like cells also were present but always in association with fibroblasts. The x-radiation sensitivities observed by single cell colony formation ranged from 41 to 480 rads for 37 per cent survival. Individual cultures shifted their sensitivities widely with time and with changes in the epithelial to fibroblast ratio. Chromosome studies indicated constancy of the normal karyotype during the culture period. Radiation produced typical aberrations. (auth)

26798 THE EFFECT OF X-RADIATION ON NUCLEAR SYNTHESIS OF PROTEIN AND DNA. D. Killander, Christina Ribbing, N. R. Ringertz, and B. M. Richards (Karolinska Institutet, Stockholm and Medical Research Council Biophysics Research Unit., London). Exptl. Cell Research, 27: 63-9(June 1962).

The total dry mass and DNA content of nuclei in cells of the Ehrlich mouse ascites tumour were determined by scanning microinterferometry and by microphotometry of Feulgen stain. The results for samples taken at various intervals following a whole-body dose of 1100 r x rays were compared with those for the control unirradiated sample. By directly plotting total dry mass against DNA content for the same individual nuclei, it was shown that in cells which had ceased to synthesize DNA, having accumulated it up to the normal pre-mitotic amount, the nuclei continued to synthesize or accumulate protein up to several times more than the normal pre-division value. It is suggested that this

protein is nonchromosomal and may not have been synthesized in the nucleus. (auth)

26799 PREVENTION OF MITOTIC DELAY IN IRRADIATED SUSPENSION CULTURES OF L MOUSE CELLS BY AGMATINE. J. F. Whitefield, R. H. Rixon, and T. Youdale (Atomic Energy of Canada Ltd., Chalk River, Ont.). Exptl. Cell Research, 27: 143-47(June 1962).

An organic amine, agmatine, causes the chromatin of L mouse cells to aggregate. This effect is reversible. Agmatine (0.05 to 0.1 M) has the additional property of preventing postirradiation mitotic delay in suspension cultures irradiated with 1000 r of x rays. It is proposed that agmatine prevents mitotic delay by counteracting radiation-induced chromosome uncoiling resulting from increased cellular permeability with loss of accumulated chromosome coiling agents. (auth)

26800 PREVENTION OF POSTIRRADIATION MITOTIC DELAY IN CULTURES OF L MOUSE CELLS BY CALCIUM SALTS. J. F. Whitefield and R. H. Rixon (Atomic Energy of Canada Ltd., Chalk River, Ont.). Exptl. Cell Research, 27: 154-7(June 1962).

Calcium salts in sufficiently high concentrations were found to be effective in preventing postirradiation mitotic delay in irradiated suspension cultures of mouse cells. Possible reaction mechanisms are discussed. (C.H.)

26801 DETERMINATION OF THE DRY MASS OF RAT LIVER CELLS TO STUDY THE PROTECTIVE MECHANISM OF CYSTEAMINE AGAINST WHOLE-BODY X-IRRADIATION. P. De, R. Chatterjee and A. Bose (Chittaranjan National Cancer Research Center, Calcutta). Exptl. Cell Research, 27: 168-9(June 1962).

An interference microscope was used in Cytointerferometric measurements of the dry mass of cytoplasm, heterochromatin, and nucleolus of fixed rat hepatic cells in tissue sections. The specific refractive increment of protein in glycerine was employed in dry mass calculations on cells from normal control, irradiated control, and cysteamine-protected rats. The values for heterochromatin and nucleolus in the liver cells of cysteamine-protected rats were considerably higher than in cells of irradiated controls. (C.H.)

26802 CLINICAL OBSERVATIONS ON CATTLE EXPOSED TO LETHAL DOSES OF IONIZING RADIATION. Daniel G. Brown (Agricultural Research Lab., Oak Ridge, Tenn.). J. Am. Vet. Med. Assoc., 140: 1051-5(May 15, 1962).

A concise discussion of the clinical syndrome of cattle exposed to lethal doses of Co^{60} gamma radiation is given. (P.C.H.)

26803 ELECTRON MICROSCOPY OF LYSOSOME-RICH FRACTIONS FROM RAT THYMUS ISOLATED BY DENSITY-GRADIENT CENTRIFUGATION BEFORE AND AFTER WHOLE-BODY X-IRRADIATION. Y. E. Rahman (Argonne National Lab., Ill.). J. Cell Biol., 13: 253-60 (May 1962). (UAC-5718)

Fractions from rat thymus were isolated by sucrose density-gradient centrifugation, before and after 1000 r whole-body x-irradiation, and examined by electron microscopy. Cytochrome oxidase and acid phosphatase activities of these fractions were tested as well. Electron-dense bodies of a diameter ranging from 0.13 to 0.34 μ and a mean diameter of 0.25 μ were found in fractions having high acid phosphatase activity, while the fractions rich in cytochrome oxidase consisted mostly of mitochondria. The electron-dense bodies were found to be increased relatively in number after irradiation. These particles are considered to be lysosomes similar to those identified in other rat tissues. Their relationship to the mitochondria is discussed. (auth)

26804 EFFECTS OF HEAVY, IONIZING, MONOENERGETIC PARTICLES ON THE CEREBRAL CORTEX. I. PRODUCTION OF LAMINAR LESIONS AND DOSIMETRIC CONSIDERATIONS. Leonard I. Malis, Charles P. Baker, Lawrence Kruger, and Jerzy E. Ross (Brookhaven National Lab., Upton, N. Y.; Johns Hopkins Univ., Baltimore; and Mount Sinai Hospital, New York). J. Comp. Neurol., 115: 219-41(Dec. 1960). (BNL-4860)

A technique is described that was used to produce laminar lesions at different depths of the cerebral cortex in rabbits, cats, and monkeys by means of heavy, ionizing particles delivered in a beam from a 60-in. cyclotron. Dosimetric problems are discussed in detail. Examination of 384 radiation lesions indicated that a laminar lesion was produced by peak doses of 15000 to 45000 rads. The corresponding surface and average doses were 3000 to 9000, and 5000 to 15000 rads respectively. A technique of multiple irradiations with a shift of the zone of maximal ionization is described. Some observations pertaining to the latent period of radiation lesions of the brain and data on the relation between the width of the laminar lesion and the magnitude of the radiation dose are presented and discussed. (C.H.)

26805 EFFECTS OF HEAVY IONIZING, MONOENERGETIC PARTICLES ON THE CEREBRAL CORTEX. II. HISTOLOGICAL APPEARANCE OF LAMINAR LESIONS AND GROWTH OF NERVE FIBERS AFTER LAMINAR DESTRUCTIONS. Jerzy E. Rose, Leonard I. Malis, Lawrence Kruger, and Charles P. Baker (Brookhaven National Lab., Upton, N. Y.; Johns Hopkins Univ., Baltimore; and Mount Sinai Hospital, New York). J. Comp. Neurol., 115: 243-95 (Dec. 1960). (BNL-4861)

A laminar lesion is defined as a sharply delineated, narrow zone in which all nerve cells are destroyed by radiation. Histological characteristics are described of laminar lesions of the cerebral cortex of rabbits produced by monoenergetic heavy particles. It was observed that new nerve fibers eventually appeared in great numbers in the zone of total cellular destruction and the fibrillar architecture of the cerebral cortex returned to a normal appearance with time. Implications of the findings are discussed. (C.H.)

26806 SOME EFFECTS OF IONIZING RADIATIONS ON THE ALKALINE PHOSPHATASE IN COW'S MILK. G. Glew (Wantage Research Lab., Berks, Eng.). J. Dairy Research, 29: No. 1, 1-10(Feb. 1962). (AERE-R-3363)

The effects of ionizing radiation on the alkaline phosphatase activity of milk were studied under different environmental conditions. Twenty-five megarads were required to inactivate the enzyme completely. A combination of heat treatment and irradiation given either before or after heating showed that inactivation of the enzyme was greater when heating occurred after irradiation, this effect of the different forms of energy possibly indicating different mechanisms of heat inactivation. Varying the dose rate over the range 12-250 krad/min did not affect the amount of enzyme inactivated. After irradiation, activity declined during storage at 30°C but not at 5°C. Irradiation did not change the value of K_m yet the V_{max} fell, indicating that there are fewer active sites present after irradiation but that affinity of the remaining sites for the substrate remains unchanged. (Public Health Eng. Abstr. 42: No. 7, July 1962)

26807 RADIATION MALFORMATIONS BELONGING TO THE CYCLOPIA-ARRHINECEPHALIA-OCTOCEPHALIA

GROUP IN THE MOUSE FETUS. Ujihiro Murakami, Yoshiro Kameyama, Akio Majima, and Tsuneyoshi Sakurai (Nagoya Univ., Japan). J. Embryol. Exptl. Morphol., 10: 64-72(Mar. 1962).

Pregnant mice on the 8½th day of gestation were subjected to 200 r whole-body irradiation and the fetuses were examined on the 13th to 19th day of gestation. Incidence of fetal death (23.0%) was much higher than in the controls (8.2%), and malformations of the nose, eyes, and ears occurred in 32%. These malformations included alterations leading to a beaklike snout (19%), a univentricular telencephalon with cyclopia (6%), and forms transitional between these two (6%). These malformations were specific for irradiation on the 8½th day of gestation. In previous studies they were not prominent when irradiation was carried out on the 8th, 10th, or 11th day. During this most sensitive developmental stage at 8½ days, 3 to 5 brain vesicles are formed and the anterior neuropore is closed, which may account for the greater effect of teratogenic agents on the central nervous system at this time. Other abnormalities included exencephalia (2%), hydrocephalus (4%), microcephalia (0.7%), abnormally shaped head (5%), spinal cord anomalies (6%), eye anomalies (29%), harelip and cleft palate (12%), tail abnormalities (6%), and thoraco-abdominal hernia (5%). (H.H.D.)

26808 ODDITY-REVERSAL AND DELAYED-RESPONSE PERFORMANCE OF MONKEYS PREVIOUSLY EXPOSED TO FOCAL-HEAD IRRADIATION. A. A. McDowell, W. Lynn Brown, and R. K. White (Univ. of Texas, Austin). J. Genet. Psychol., 99: 75-81(Sept. 1961).

Control monkeys and monkeys with previous focal-head exposure to x radiation, some with irradiation of the frontal association areas and some with irradiation of the posterior association areas, were tested both on an oddity-reversal problem which required the utilization of the same stimulus cues in antagonistic response patterns for correct solution and on spatial delayed-response problems. With respect to the oddity-reversal problem, a statistically significant increase in both errors and days to criterion on reversal learning over errors and days to criterion on original learning was found. The radiation groups differed significantly with respect to days to criterion, but not with respect to errors to criteria, the frontal irradiates requiring the greatest number of days and the posterior irradiates the least. A significant groups by conditions interaction was found in the days to criterion analysis. This interaction was interpreted as meaning that the amount of increase in days to criterion on reversal learning was significantly greater for the frontal irradiates than for either of the other two groups. These results are diagnostic of neural tissue damage in the frontal focal-head irradiated monkeys. With respect to delayed-response testing, no significant differences were found. These results do not suggest neural tissue damage in the frontal focal-head irradiated monkeys. These findings are discussed in terms of their possible value for future study of the functions of the frontal lobes. (auth)

26809 TRIAL OF AN ANALYTIC REPRESENTATION OF THE INTEGRAL DOSE. J. Dutreix, A. Dutreix, and P. Gallé. J. Radiol., Electrol. Med. Nucl., 43: 275-82 (May 1962). (In French)

The concept of integral dose has been introduced in radiotherapy as the expression of a simple physical characteristic to which is bound the whole of the biological effects produced in the entire irradiated system. The clinical value of such a concept finds confirmation in the correlation noted between the integral dose and some systemic or regional reactions. However, the clinical meaning of integral dose is not univocal. The distribution of the integral dose allows a representation of the general irradiation of the system more detailed than the global integral dose and evidences in an expressive mood the differences between various types of irradiation. Nevertheless, it has a purely physical meaning. For transforming such physical data in biological ones, it would be necessary to affect each of the dose values with an efficiency factor and, on the other hand, taking in consideration that the system is biologically heterogeneous, it would be convenient to distinguish within each set of integral dose the parts corresponding to the various tissues and to ponderate them with a sensitiveness factor proper to each of these tissues. It is evident that the present radiobiologic data do not allow to reach those two ponderation factors. The distribution of the integral dose has therefore no absolute biological meaning, but it constitutes a strictly necessary step towards the determination of a biological characteristic more representative of the general effect of the irradiation. The determination of the distribution of the integral dose does not raise any major practical problem; it may be established without any difficulty when the distribution of the dose within the totality of the irradiated system is known; it constitutes, after all, a peculiar synthesis of this distribution that by itself lends itself poorly to the contemplated representation. In a number of cases, it constitutes a step in the calculation of the total integral dose and it is yet sufficient to transcribe the details of this calculation, instead of producing its global sum. With regard to the methods that make use of some arts for the direct determination of the integral dose, this analysis represents an unquestionable complication, that is however justified by the more detailed representation thus allowed. (auth)

26810 STERILIZATION METHOD WITH A HIGH ENERGY ELECTRON BEAM. Jean-Marie Lefebvre (Massachusetts Inst. of Tech., Boston). J. Radiol., Electrol. Med. Nucl., 43: 305-6(May 1962). (In French)

A number of experiments have established, without any doubt, that the physical and biochemical reactions producing the destruction of microorganisms consecutive to the exposure to a beam of x or gamma rays or to the irradiation with a high energetic electron beam are basically similar. In both instances there is, before all, absorption of the beam energy by excitation and ionization of absorbing molecules. Experience has evidenced that doses of about 2 millions rads are necessary for a good sterilization. The delivered dose depends from the energy of the electron beam, from the intensity of the same, and from the passage speed of the material (usually beam grafts) under the beam. For an identical energy and an identical passage speed of the samples under the beam, there is a linear variation with regard to the beam intensity; it is very easy to read with great precision, on a amperemeter, the delivered dose. Practically, and taking in account the time necessary for the manipulation and the various regulations of the accelerator, the sterilization of 20 grafts takes place in about 5 minutes. The grafts are contained in a double water-tight envelope made of polyethylene, and, as sterilization is total within such envelopes, any kind of caution is needless for the manipulation of the same that will be opened, in the operation-room immediately before the use of their contents. (auth)

26811 RADIOBIOLOGICAL STUDIES ON PLANTS. IV. GAMMA-RAY-INDUCED CHLOROPHYLL MUTATIONS AND MUTATION FREQUENCIES IN WHEAT AND OATS. Ichizo Nishiyama and Sadao Ichikawa (Kyoto Univ.). Japan J. Genetics, 36: 175-83(June 1961). (In English)

Seeds of Triticum vulgare, Avena sativa (monosomic plants), and A. strigosa were irradiated with gamma-rays

from a Co^{60}-source and induced chlorophyll mutations and mutation frequencies were investigated in their X_2, X_3, and X_4 progenies. Chlorophyll mutations were found in two species of oats. In A. sativa, four kinds of chlorophyll mutations, yellow, cream-I, -II and stripe, were obtained. In A. strigosa, nine kinds, albino-I, -II, -III, -IV, -V, whitish cream, cream stripe, yellow stripe, and stripe, were obtained. But no chlorophyll mutation was found in T. vulgare. Albino was obtained most frequently and it constituted 46.7% of all the chlorophyll mutants of A. strigosa. Chlorophyll mutation frequency per r-unit per spike or panicle progeny was 0×10^{-6} in T. vulgare, 3.9×10^{-6} in A. sativa and 7.0×10^{-6} in A. strigosa. Mutants were due to a single or to two independent gene mutations. Some mutants showed significantly lower segregation ratios than the expected ones. (auth)

26812 REMARKS ON THE TREATMENT OF TUMORS OF THE BLADDER BY MEANS OF BETATRON. N. Marocco and E. Peracino (Università Turin). Minerva nucleare, 6: 156-60(May 1962). (In Italian)

Thirty-four patients with 4th. grade cancer of the bladder are reported. The type of treatment given is described and the results obtained are discussed, especially as regards the survival, the symptomatology, and the endoscopic picture. The efficacy of betatron treatment is compared with that of conventional radiotherapeutic methods. (auth)

26813 A COMPARATIVE STUDY OF HEMOGRAM OF HEART AND TAIL BLOOD IN BOTH IRRADIATED AND NON-IRRADIATED RATS. Subhas Ranjan Basu (Saha Inst. of Nuclear Physics, Calcutta). Naturwissenschaften, 49: 234(1962). (In English)

A study was made to determine if there is any difference in the morphological picture of heart blood and tail blood of white albino rats, both irradiated and non-irradiated. Blood samples from heart and tail were analyzed for erythrocyte counts, leukocyte counts, hemoglobin values, and leukocyte differentials. The results were tabulated and clearly show there is no difference in the morphological picture of blood collected from tail and heart. (J.S.R.)

26814 THE EFFECT OF THE CONCENTRATION OF ISOLATED CHLOROPLASTS ON THE INACTIVATION OF PHOTOPHOSPHORYLATION AND THE HILL REACTION BY X RADIATION. W. Fuechtbauer and W. Simonis (Universität, Würzburg, Ger.). Naturwissenschaften, 49: 237-8 (1962). (In German)

The activity of chloroplasts after irradiation was measured as a function of their concentration during irradiation. The results are tabulated and show that the concentration of whole chloroplasts has a strong effect on their relative inactivation. The result that phosphorylation of the chloroplast is more radiosensitive than the Hill reaction was confirmed by consideration of the dilution effect. The dependence of the relative inactivation of chloroplasts on their concentration proves the preponderant contribution of indirect radiation effects. (J.S.R.)

26815 EFFECT OF SODIUM CITRATE ON THE BREAKDOWN OF DESOXYRIBONUCLEIC ACID OF ESCHERICHIA FREUNDII INDUCED BY RADIATION. P. M. Osterrieth (Université, Liège). Naturwissenschaften, 49: 242(1962). (In English)

The radioinduced breakdown of desoxyribonucleic acid (DNA) was investigated on Escherichia freundii grown to the stationary phase in a mineral medium containing glucose as a sole organic substance. Bacteria suspended in distilled water and irradiated show an early breakdown of the DNA that continues during incubation. High concentrations of sodium citrate inhibits this breakdown but low concentrations increase the breakdown. The addition of calcium chloride and magnesium sulfate to low concentrations of sodium citrate decreases the accelerating effect. Various hypotheses on the mechanism of radioinduced breakdown are discussed in the light of the sodium citrate effect. (J.S.R.)

26816 EFFECT OF RED AND FAR-RED IRRADIATION ON NUCLEOTIDE PHOSPHATE AND ADENOSINE TRIPHOSPHATE LEVELS IN DARK-GROWN BEAN AND AVENA SEEDLINGS. Edward C. Sisler and William H. Klein (Smithsonian Inst., Washington, D. C.). Physiol. Plant., 14: 115-23(1961).

The adenosine triphosphate (ATP) content of Black Valentine bean seedlings and of the Avena coleoptile and mesocotyl has been investigated in relation to red (600 to 700 mμ) and far-red (700 to 750 mμ) radiant energy responses. The nucleotide phosphate and ATP contents of the leaves, hypocotyl hook, elongated portion of the hypocotyl, and roots of 6-day-old dark-grown bean plants were proportional to the protein content. No detectable differences in the ATP level could be measured upon irradiation of the bean hooks with either red or far-red radiant energy. Dinitrophenol (10^{-4} M) reduced the ATP level of hooks to approximately 50% of the level of control hooks. When exposed to red radiant energy, the dinitrophenol-treated hooks of bean plants responded to about 60% of the response induced in the control. The ATP levels in the coleoptile and mesocotyl of Avena also were not influenced by red light. These results are interpreted as indicating the ATP is required for a light-induced growth response to occur, but alteration of the ATP level by red, far-red irradiation is probably not the system regulated by the photoreaction. (auth)

26817 ELECTRON MICROSCOPE OBSERVATIONS OF RADIATION-INDUCED HELA GIANT CELLS. James K. Koehler (Univ. of California, Berkeley). Protoplasma, 54: 493-503(1962). (UCRL-9226). (In English)

An electron microscope study of X-ray produced giant Hela cells is described. The results extend earlier light microscope observations to the sub-microscopic region where clear differences from normal structures are apparent. Of particular interest are intranuclear inclusions, nucleolar fragments, membrane abnormalities, and possible mitochondrial changes. (auth)

26818 CHLOROPHYLL SYNTHESIS IN X-IRRADIATED ETIOLATED BEAN LEAF TISSUE. L. Price and W. H. Klein (Smithsonian Institution, Washington, D. C.). Radiation Botany, 1: 269-75(June 1962).

X-irradiated etiolated bean leaf tissue exhibits a marked reduction of chlorophyll synthesis when exposed to continuous white light of high intensity. However, chlorophyll synthesis is appreciably increased in this x-irradiated tissue if subjected to a few minutes of visible radiant energy either before or after x-irradiation, then placed in the dark for several hours, and subsequently exposed to high intensity white light. This light pretreatment, furthermore, appears to be much more effective in the red than in the blue region of the spectrum. The response to light pretreatment of x-irradiated leaves is markedly similar to that found in control samples of non-x-rayed tissue. Rather than an interaction of ionizing radiation and nonionizing radiant energy, light pretreatment appears to induce an independent photomorphogenic response related to the chlorophyll-synthesizing mechanism which is superimposed upon the damage resulting from x-ray dosages. (auth)

26819 THE GENETICAL CONTROL OF RADIOSENSITIVITY. II. GROWTH MEASUREMENTS IN

LYCOPERSICUM AND MELANDRIUM. D. R. Davies (Wantage Research Lab., Berks, Eng.). Radiation Botany, 1: 277-95(June 1962).

A genetical control of radiation response has been detected in Lycopersicum and Melandrium species. The nature of this control was investigated by analyses of the progenies of a diallel cross of six genotypes of Lycopersicum and of five genotypes of Melandrium. Seeds and seedlings were irradiated and growth measurements taken at various stages of development. There were numerous difficulties associated with the utilization of growth data for the assessment of comparative radiosensitivity, the most important being the strong positive correlation between control values and the degree of growth depression. A metric of sensitivity had to be calculated which removed this correlation. Evidence of both additive and dominance variation was found and also of pronounced reciprocal differences. The genetical control varied according to the stage irradiated and the stage measured. The significance of this variation and of the reciprocal differences is considered, and the value of growth data for radiobiological investigations discussed. (auth)

26820 THE INDUCTION OF SPORTS IN CHRYSANTHEMUMS BY GAMMA RADIATION. H. J. M. Bowen, P. A. Cawse, and M. J. Dick (Wantage Research Lab., Berks, Eng.). Radiation Botany, 1: 297-303(June 1962).

The effect of gamma rays from cobalt-60 on cuttings of seven chrysanthemum varieties has been studied. The LD_{50}s for the cuttings were in the range 3.0–4.3 krad. Irradiation caused plants to flower much later than controls. About 40 per cent of the irradiated plants showed colour sports; the overall percentage of sports and the percentages of different types depended markedly on variety. One sport of one variety appeared to be caused by the breaking of a periclinal chimaera. The remainder were believed to be mutants in the broadest sense of the term. The number of mutant cells was estimated to lie between 2.2 and 27 per 10^6 cells per krad. Most sports were produced by irradiating varieties with a chromosome number of 54 and fewest from those with the highest chromosome numbers. A hypothesis is advanced that radiation-induced sports may have more chromosomes than their parent, but rarely have less. (auth)

26821 ELECTRON-MICROSCOPE STUDIES OF X-RAY DAMAGE TO FROG BLOOD CELLS. Milton A. Lessler and Freda M. Herrera (Ohio State Univ., Columbus). Radiation Research, 17: 111-17(Aug. 1962).

A technique for the preparation of osmium-fixed ultrathin-sectioned frog blood cells for examination in the electron microscope is described. Erythrocytes exposed to 1000 rads x radiation were swollen in appearance and had abnormal bulging nuclei. Mitochondria were demonstrated in frog erythrocytes, and exposure to 1000 rads apparently disrupted their internal structure. Electron micrographs of white cells after irradiation showed increased vacuolization of the cytoplasm. (auth)

26822 INCREASED SENSITIVITY TO X-IRRADIATION EXHIBITED BY STRESSED RATS. Charles E. Hall, M. Schneider, and O. Hall (Univ. of Texas, Galveston). Radiation Research, 17: 118-26(Aug. 1962).

Electroshock stress applied prior to x irradiation does not affect survival or survival rate of rats exposed to 640 r, whereas if applied afterward it decreases both. Stress incurred by rats during shipment to the laboratory, followed shortly by irradiation, reduces their survival and increases mortality rate. Variations in the duration and intensity of stress incident to the handling of animals in order to irradiate them might well contribute to the severity of injury sustained. This could account, in part, for variations in survival rate and survival from group to group at the LD_{50} level as reported by others and noted. The stresses used in this study were limited to a relatively brief period either pre- or postirradiation. In this way biologic exhaustion and biologic adaptation were minimized. This is in contrast to most studies, in which stress has either been applied for weeks or months, before or after x irradiation, or has been imposed to a degree which left the subjects in a state of exhaustion. (auth)

26823 LIVER CHANGES IN SUBLETHALLY IRRADIATED MICE UNDERGOING THE FOREIGN SPLEEN REACTION. M. L. Davis, G. E. Cosgrove, and W. D. Gude (Oak Ridge National Lab., Tenn.). Radiation Research, 17: 133-9(Aug. 1962).

Changes in the morphology and functions of the liver in sublethally irradiated mice with the foreign spleen reaction were studied by using the bromosulfalein test (BSP) and histologic and histochemical methods. Marked dye retention, fat deposition, and liver cell vacuolation were found at the peak of the reaction. Control mice, receiving only x radiation, had normal dye retention with the BSP test and only slight fat infiltration and liver cell vacuolation. (auth)

26824 CHANGES INDUCED IN THE MOUSE SPLEEN BY GRADED DOSES OF TOTAL-BODY X-IRRADIATION. N. B. Kurnick and Naime Nokay (Veterans Administration Hospital, Long Beach, Calif. and Univ. of California, Los Angeles). Radiation Research, 17: 140-4(Aug. 1962).

With increasing x ray dose administered 24 hours before sacrifice, the DNase content per average spleen cell increased progressively from normal to 500% of normal at 800 r of total-body exposure (LD_{100}) and then remained essentially unchanged at higher doses. The most rapid change occurred between 0 and 250 r, when it was 250% of normal. Simultaneously, the weight and total cellularity (DNA content) fell, most rapidly after doses of 0 to 250 r, and then more slowly to 800 r. Twenty-four hours after a dose of 250 r, the total DNA content was 47% of normal, and after 800 r and 1500 r it was 21% of normal. The observed changes, which are apparent after as little as 30 r, suggest that there may be no threshold for the effects of x irradiation. (auth)

26825 BIOLOGICAL EFFECTS OF CARBON-14 INCORPORATED INTO NUCLEIC ACIDS OF MOUSE EMBRYOS. Linda Simpson and L. L. Bennett, Jr. (Southern Research Inst., Birmingham, Ala.). Radiation Research, 17: 145-57(Aug. 1962).

The biological effects of the incorporation by the mouse embryo of high levels of C^{14} were studied in experiments in which sodium formate-C^{14} or nonradioactive sodium formate was administered intraperitoneally to mice during gestation. Mice that had received formate-C^{14} produced litters that were normal in all respects when compared with litters of nonradioactive animals. On the basis of the observation that C^{14} incorporated during embryonic development may be retained in the DNA of certain organs for the life of the animal, large groups of mice that had received either formate-C^{14} or nonradioactive formate during embryonic development were observed over their life span in an attempt to detect radiation damage to somatic cells. As compared with nonradioactive animals, mice that had received C^{14} showed no differences in weight or longevity or in the incidence of tumors. When large groups of 2-month-old males and females that had received C^{14} during their embryonic development were mated with each other or with nonradioactive animals, no evidence was obtained

for a lowered fertility in the groups in which the males or females or both had received C^{14}. (auth)

26826 THE INDUCTION OF ADENOMAS BY THE IRRADIATION OF SALIVARY GLANDS OF RATS. A. Gluecksman and C. P. Cherry (Strangeways Research Lab., Cambridge, Eng.). Radiation Research, 17: 186-202(Aug. 1962).

Local irradiation induces adenomas in the three major salivary glands of rats. Their incidence varies with dose, over-all time of treatment, and sex of the animals. The sublingual gland is most and the parotid the least prone to adenoma formation; the submandibular gland is intermediate. With fractionated protracted doses of x rays the tumor formation is greater than with concentrated smaller doses in the parotid, the submandibular, and the skin, but lower in the sublingual. For the same dose of x rays the sublingual produces 100% adenomas in males and 80% in females, but none in castrated females. Adenomas occur only in regions in which the acini have disappeared. They are of acinar type in the sublingual and submandibular, formed by the proliferative activity of intercalated ducts. In the parotid they are of tubular type and formed by dedifferentiated ducts. Radiation causes compensatory secretory activity in the intercalated ducts of the sublingual and the tubules of the submandibular gland but the disappearance of secretory granules in the intercalated ducts of the parotid. Adenoma formation follows the stimulation of regenerative activity in intercalated ducts and in the parotid of excretory ducts by the progressive disappearance of acini and the compensatory activity of the secretory tubules. It is influenced by the sex of the rats and by the type of radiation treatment, but is not a function of radiation dose. (auth)

26827 A STUDY OF THE EFFECTS OF REPEATED IRRADIATION ON THE CYSTS OF A CILIATE, TILLINA MAGNA. Josephine Bridgman and Charlotte King (Agnes Scott Coll., Decatur, Ga. and Marine Biological Lab., Woods Hole, Mass.). Radiation Research, 17: 203-8(Aug. 1962).

Experiments with repeated x irradiation of Tillina magna cysts indicate that there is a decrease in the number of divisions with higher present doses of radiation, both when these doses have been preceded by one or more radiation exposures and when they have not. Since previous dose seems not to increase the division rate after a given present dose, Tillina magna does not acquire resistance to radiation. There is slight evidence for accumulation of radiation effect from repeated exposures. The average number of divisions appears to be more nearly a function of the present dose than of the total accumulated dose. Since there is little evidence of residual effect from radiation it must be concluded that there is recovery in Tillina magna cysts. (auth)

26828 STUDIES ON THE CHEMICAL COMPOSITION OF THE CENTRAL NERVOUS SYSTEM IN RELATION TO THE EFFECTS OF X-IRRADIATION AND OF DISTURBANCES IN WATER AND SALT BALANCE. I. CHEMICAL COMPOSITION OF VARIOUS SPECIFIC AREAS AND STRUCTURES OF THE BRAIN IN THE DOG AND THE MONKEY. Mangus I. Gregersen, Charles Pallavicini, and Shu Chien (Columbia Univ., New York). Radiation Research, 17: 209-25(Aug. 1962).

A method is described in which a train of chemical analyses can be performed on 0.5- to 1.0-gm samples of brain tissues whereby water, total lipid, total nitrogen, chloride, sodium, potassium, and magnesium can be determined in succession. In 19 normal dogs and 2 normal monkeys, the gray matter and caudate nucleus were found to have water (about 80%) and lipid (4 to 5%) contents quite different from those of the white matter (water 68%, lipid 17%). The sum of water and lipid in these as well as in other tissues (corpus callosum, thalamus, medulla oblongata) was between 83% and 86%. The gray and white matter had the same concentrations of Na (79) and K (125), whereas the caudate nucleus had lower concentrations (Na 68, K 113), all in milliequivalents per kilogram of H_2O. The chloride space of all tissues analyzed ranged from 26 to 31% of the fresh weight, or 37 to 42% of the total water. The variance of the values for the chemical constituents determined in different animals was quite small, thus permitting the comparison of these normal data with those obtained under pathological conditions. Most of the variance observed was probably due to true individual variations, since in the same animals the results obtained on the two sides of the brain showed very good agreement and the water contents of various parts of the brain showed definite correlation. (auth)

26829 STUDIES ON THE CHEMICAL COMPOSITION OF THE CENTRAL NERVOUS SYSTEM IN RELATION TO THE EFFECTS OF X-IRRADIATION AND OF DISTURBANCES IN WATER AND SALT BALANCE. II. EFFECTS OF X-IRRADIATION ON THE CHEMICAL COMPOSITION OF BRAIN TISSUES IN DOGS. Magnus I. Gregersen, Charles Pallavicini, and Shu Chien (Columbia Univ., New York). Radiation Research, 17: 226-33(Aug. 1962).

The effects of x irradiation on the chemical composition of gray matter, white matter, and caudate nucleus were studied in dogs. Three to four days after 1000 r of total-body irradiation, the water content increased in the gray and white matter, Na concentration increased in the gray and caudate, and K concentration decreased in the gray and white. Four to ten days after 2000 to 5000 r of head irradiation, there was no significant change in the water content of brain tissues, and the only marked changes were the increases in Na concentration in all three tissues analyzed. After 20,000 r of head irradiation, Na and Cl showed significant increases in the caudate nucleus, but there was no striking alteration in water content of other brain tissues sampled. Since the swelling (increase in water content) of brain seen after 1000 r of total-body irradiation was not observed after head irradiation, it was probably not caused by the direct effect of x rays, but was rather a secondary effect of irradiation. The increase in Na in caudate nucleus after head irradiation may be related to the functional disturbances of the extrapyramidal system. (auth)

26830 STUDIES ON THE CHEMICAL COMPOSITION OF THE CENTRAL NERVOUS SYSTEM IN RELATION TO THE EFFECTS OF X-IRRADIATION AND OF DISTURBANCES IN WATER AND SALT BALANCE. III. EFFECTS OF DISTURBANCES IN WATER AND ELECTROLYTE BALANCE ON THE CHEMICAL COMPOSITION OF BRAIN TISSUES IN DOGS. Shu Chien, Charles Pallavicini, Louis J. Cizek, and Magnus I. Gregersen (Columbia Univ., New York). Radiation Research, 17: 234-43(Aug. 1962).

The chemical composition of gray matter, white matter, and caudate nucleus was determined in dogs subjected to various types of disturbances in water and electrolyte balance, and the results were compared with those obtained on normal dogs. Intraperitoneal dialysis resulted in the depletion of Na, K, and Cl and an increase in intracellular hydration (calculated from Cl space). Water loading caused an increase in water content and dilution of electrolytes. After sucrose diuresis, the brain lost more water than electrolytes, and hence the concentration of the latter (in milliequivalents per kilogram of H_2O) increased. As a result of the injection of hypertonic NaCl solution, the Na and Cl concentrations increased markedly, whereas the water

content decreased. These changes in the brain are qualitatively the same as those occurring elsewhere in the body. Even from a quantitative point of view, the changes in the brain are similar to those found in other tissues. Therefore, the brain is not always specifically guarded against chemical changes, and the methods employed were adequate for the detection of the changes in chemical composition of brain tissues. In the experiments where x irradiation was superimposed on the disturbances in fluid balance, beside the findings attributable to the latter maneuvers, there was an increase in the Na concentration of the caudate nucleus similar to that found in the dogs receiving x irradiation only. (auth)

26831 STUDIES ON THE CHEMICAL COMPOSITION OF THE CENTRAL NERVOUS SYSTEM IN RELATION TO THE EFFECTS OF X-IRRADIATION AND OF DISTURBANCES IN WATER AND SALT BALANCE. IV. EFFECTS OF X-IRRADIATION ON THE CHEMICAL COMPOSITION OF RABBIT BRAIN. George R. Rowley and Robert J. Dellenback (Columbia Univ., New York). Radiation Research, 17: 244-52(Aug. 1962).

Normal values for the per cent water, lipid, protein, and undigested residue as well as the sodium and potassium content (milliequivalents per kilogram of fresh tissue) are reported for various regions of the brain of rabbits approximately 1 year old. No significant change occurs in the water content of the gray matter, medulla, cerebellum, or mid-brain of rabbits sacrificed 7 days after 2.0 kr of x irradiation. A significant increase in the per cent lipid and protein occurs in the mid-brain region. A significant decrease occurs in the undigested residue fraction of the cerebellum. A significant increase occurs in the sodium content of the cerebral gray matter. There is no significant change in the potassium content of any region of the brain studied in this investigation. (auth)

26832 THE EFFECT OF Co^{60} GAMMA RADIATION ON THE IN VITRO DEVELOPMENT OF THE EMBRYONIC LUNG OF THE MOUSE. Tommaso Alescio and Mario Ladu (Comitato Nazionale per l'Energia Nucleare, Francati, Italy). Radiobiol. Latina, 4: 207-41(July-Sept. 1961). (In Italian)

The action of Co^{60} gamma rays on the in vitro development of the embryonic mouse lung was studied, and successive alterations which take place in living cultures are described. First, the rudiments become opaque because large quantities of cell debris are discharged into the lumina of the bronchi. A repair phase then follows during which the debris is dispersed and expelled and the original transparency at least partially restored. Branching appears greatly retarded and sometimes completely halted. The histological changes consist initially of rapid degeneration of the epithelium which starts in the trachea and spreads progressively through the bronchial tree. The terminal buds are always markedly more radioresistant in the early stages. Subsequently, the bronchial tree shows a considerable capacity to regenerate which allows a certain revival of the morphogenetic process, although the various changes described persist. The mesenchyme hardly appears to be affected during the initial phase of epithelial degeneration, but, during the second phase undergoes an apparently irreversible process of degeneration. (auth)

26833 HISTOLOGICAL AND HISTOCHEMICAL STUDY OF IRRADIATED HYPOPHYSIS DURING HYBERNATION. Pratesi A. Cavina, G. R. Bandirali, and C. Vassallo (Università, Pavia, Italy). Radiobiol. Latina, 4: 243-56(July-Sept. 1961). (In Italian)

After having made a histological and histochemical study of the hypophysis in animals irradiated during hibernation, it was concluded that the damage produced by irradiation during the period of hibernation is less. The hypothesis that the radioresistance of animals given whole-body irradiation during hibernation is also an expression of the diminution in cell-damage in the endocrine glands is discussed. (auth)

26834 THE ELECTROPHORETIC BEHAVIOR OF SERUM PROTEINS, OF PERCHLORIC ACID MUCOPROTEINS, AND OF THE COLLOIDAL SERUM LABILITY IN CANCEROUS TISSUES EXPOSED TO IRRADIATION. Renato Sorrentino and Ezio Fumagalli (Istituto Radiologico Ospedale Maggiore, Novara, Italy). Radiobiol. Latina, 4: 257-74(July-Sept. 1961). (In Italian)

In cancer cases subjected to irradiation, the electrophoretic behavior of serum proteins, perchloric acid-soluble mucoproteins, and colloid lability were investigated. After treatment it was observed that: (a) slight, statistically non-significant, alterations had occurred in the serum proteins (hypoalbuminaemia and hypergammaglobulinaemia accompanied by alteration in the albumin/globulin ratio); (b) the serum mucoprotein was reduced in the majority of cases; and (c) changes in colloid lability were rare. Some time after treatment, the alterations in proteins, especially in the mucoproteins, showed a tendency to revert to basal levels, probably related to favorable progress of the illness. (auth)

26835 PROBLEMS OF PATIENTS' DOSIMETRY. Felix Wachsmann (Universität Erlangen, Ger.). Röntgen Bl., 15: 113-21(Apr. 1962). (In German)

Patients' dosimetry is required to avoid excess loads of x rays in individual cases and to obtain statistical data about the load of rays on patients by different examination methods and examiners. In order to decide what units appear most suitable for measuring the load of radiation, it is necessary to consider the various possibilities of damage, i.e., local damage in the field of incidence and the various organs (the gonads for example) as well as damage of a general nature. While the first mentioned type is to be measured in r or rad, the integral dose expressed in rad kg serves best as measure for the general load of radiation. Since, however, this unit can not be taken care of in a measuring-technical manner, one has to be satisfied to determine either the product of radiation dose × area ($r \times cm^2$) or the radiated energy in mWs or Joule. (auth)

26836 MOLECULAR CHANGES IN DEOXYRIBONUCLEIC ACID INDUCED BY X-RAYS. H. E. Guda, W. J. Frajola, and M. A. Lessler (Ohio State Univ., Columbus). Science, 137: 607-9(Aug. 24, 1962).

A chromatographic study of molecular changes in DNA after in vitro exposure to x rays revealed little effect on the DNA macromolecule when either intact red cells of frog or DNA isolated from these cells was exposed to 1000 r. Increasing the dose to 10,000 r resulted in a significant shift from gradients of lower molecular weight to the higher gradients. These data suggest that cross-linking of DNA occurred at the higher radiation level. (auth)

26837 PATHOGENESIS OF THE INTESTINAL LESIONS IN RADIATION CHIMERAS. M. J. de Vries (Radiobiological Inst. of Organization for Health Research T.N.O., Rijswijk Z. H., Netherlands). Transplantation Bull., 30: 13-20 (July 1962).

Irradiated mice treated with homologous lymph node suspensions were serially killed for histological examination. Beginning at the 4th day following irradiation and transplantation, repopulation of the lymphatic tissues by

lymphoid cells occurred. Concurrently excessive disintegration of crypt cells in the intestines was observed. The intestinal damage is considered to be the result of a cytotoxic action of the antibody-producing foreign lymphoid cells against the intestinal crypt cells. The intestinal lesons resemble those found in irradiated primates treated with bone marrow, but differ from those found in irradiated mice treated with bone marrow only. The implications of these findings with regard to the mortality pattern and the pathogenesis of secondary disease in radiation chimeras are discussed. (auth)

26838 INFLUENCE OF RADIATION DOSE ON INDUCTION OF THE FOREIGN SPLEEN REACTION IN F_1 HYBRID MICE. G. E. Cosgrove, A. C. Upton, and C. C. Congdon (Oak Ridge National Lab., Tenn.). Transplantation Bull., 30: 29-33(July 1962).

Parental spleen cells were injected into several strains of F_1 hybrid mice given 0 to 900 r of whole-body x radiation, and the survival, clinical appearance, and histologic changes in the recipients were studied. With two exceptions there was a threshold level of radiation below which there was no mortality. This radiation level varied with the donor-recipient strain combination, being lower in those with more marked histoincompatibility. The mortality was associated with a granulomatous reaction in lymphoid organs, atrophy of hemopoietic tissues, and outward signs of illness. Mortality occurred earlier following higher irradiation doses. Strain variations in ultimate mortality were noted. (auth)

26839 SERUM PROTEIN TYPES IN X-IRRADIATED MICE TREATED WITH HOMOLOGOUS HEMATOPOIETIC TISSUES. D. C. Shreffler (California Inst. of Tech., Pasadena). Tranplantation Bull., 30: 34-9(July 1962).

Results of a series of studies of serum protein types in x-irradiated mice treated with homologous bone marrow and fetal liver indicate that serum variants are not of value as general markers for studies of repopulation in homologous chimeras. The results showed that some cell synthesizing transferrin and serological factor are probably destroyed by radiation, and that in some instances donor cells of these types may form temporary transplants until the host recovers the ability to synthesize its own proteins. The immunological significance of the findings in transplant establishment and cellular proliferation are discussed. (C.H.)

26840 RECOVERY OF AGGLUTININ PRODUCTION IN ISOLOGOUS FETAL LIVER CHIMERAS. G. Doria and C. C. Congdon (Oak Ridge National Lab., Tenn.). Transplantation Bull., 30: 39-42(July 1962).

The ability to produce agglutinins against rat or sheep RBC was investigated in isologous fetal liver chimeras at 1 hour, and 15, 30, 45, and 60 days after irradiation and the response tested 14 days later. The recovery of these immune responses was not complete at 60 days after the treatment. The ability to respond against sheep RBC recovered faster and to a greater extent than did that against rat RBC. (auth)

26841 THE BIOLOGICAL EFFECTIVENESS OF THERMAL NEUTRONS AND OF THE HEAVY PARTICLES FROM THE $B^{10}(n,\alpha)Li^7$ REACTION FOR THE RABBIT'S EAR AND ITS UTILIZATION FOR NEUTRON CAPTURE THERAPY. Yasokazu Lucas Yamamoto (Brookhaven National Lab., Upton, N. Y.). Yokohama Igaku, 12: No. 1, 4-22(Feb. 1961). (BNL-5197)

The safe skin dose of thermal neutrons and of the heavy particles from $B^{10}(n,\alpha)Li^7$ reaction on rabbit's ears are established to be below 10×10^{12} n/cm^2 with thermal neutrons exposure alone and 1.5×10^{12} n/cm^2 with 35 mg boron-10 per kg body weight. A review of clinical data shows the maximum safe skin dose to be roughly 0.5×10^{12} n/cm^2 with 25 to 50 mg B^{10} per kg body weight. This clinical data are correlated with the results of rabbit experiments from the studies of the differences of radiosensitivity between human being and rabbit's ears. Medical uses of neutron shielding materials are discussed from the physical and biological point of view. The utilization of the above data to avoid skin complications in neutron capture therapy of human brain tumors is presented. The use of the temporary skin flap and lithium metal shielding has been successful in avoiding skin complications. The value of relative biological effectiveness is calculated to be 3.9 from thermal neutron exposure alone and to be 1.87 from neutron capture therapy from $B^{10}(n,\alpha)Li^7$ reaction with 90 mg per kg tissue weight. (auth)

26842 THE DISTRIBUTION OF LIFE SPANS IN BIOLOGICAL COLLECTIONS. A METHOD FOR THE EVALUATION OF STUDIES IN WHICH THE LIFE SPAN OF BIOLOGICAL COLLECTIONS WAS AFFECTED BY IRRADIATION OR THE INTRODUCTION OF DRUGS. A. Sippel and E. Heim. Z. Naturforsch., 17b: 406-14(June 1962). (In German)

A relationship is applied to the distribution of life spans of animals, which originally had been found when studying a different problem. The new formula is far simpler and its derivation is more evident than the formulas earlier proposed by Gompertz, Makeham or Perks. Moreover all statistical data taken from literature fit the new equation better than any other one. Using the new relationship it is possible to characterize the survival curves of normally aging biological collections as well as those of collections, the individuals of which are treated with gamma radiation on drugs, by one single constant similar to the rate constant in the case of chemical reactions. (auth)

26843 COBALT-60 STERILIZATION STUDIES WITH AEDES AEGYPTI (L). E. M. McCray, Jr., J. A. Jensen, and H. F. Schoof. p.110-15 of "Proceedings 48th Annual Meeting New Jersey Mosquito Ext. Association." 1961.

Exposure of Aedes aegypti pupae to 10500 to 17500 roentgens of gamma irradiation caused complete sexual sterilization of both males and females. Caged populations containing 500 irradiated males, 25 normal males, and 25 normal females produced eggs of which less than 2% were viable. At a ratio of 10 : 1 : 1 of sterile male : normal male : normal female, the viable egg production was less than 10%. (Public Health Eng. Abstr., 42: No. 8, Aug. 1962)

26844 EFFECTS OF IONIZING RADIATIONS ON IMMUNE PROCESSES. The Scientific Papers Presented at the International Symposium held at The University of Kansas, September 5-7, 1961. Charles A. Leone, ed. New York, Gordon and Breach Science Publishers, 1962. 532p. $12.50.

Eighteen papers were presented at this international symposium by immunologists, protein chemists, physiologists, geneticists, and other medical and biological scientists. The topics centered around the effects of ionizing radiations on immune processes and the available and possible means for the protection and cure of radiation injuries. Separate abstracts were prepared for each paper. (C.H.)

26845 THE POSSIBLE IMPORTANCE OF ENERGY TRANSFER IN RADIOBIOLOGICAL MECHANISMS. Leroy G. Augenstine (Brookhaven National Lab., Upton, N. Y.). p.17-46 of "Effects of Ionizing Radiations on Immune Proc-

esses." New York, Gordon and Breach Science Publishers, 1962. (BNL-5806)

Different energy transfer processes are discussed in a consideration of possible alternatives to some of the commonly accepted postulates of direct and indirect effects of radiation in biological systems. Four mechanisms are considered whereby an interaction in an aqueous solvent might lead to inactivation of a macromolecular solute. These include the possibilities that inactivation can be produced by more than one species of neutral water radicals, by charged entities, by other macromolecules in an excited state, or by exciton movement in the water with localization in the vibrational modes of the macromolecule. Energy acquired by the macromolecule, either directly from the radiation or from the solvent, may become interchanged between the site of the initial interaction and the site where a molcular modification corresponding to damage is first manifested. There is good evidence of extensive exciton movement in helical DNA with damage most likely to occur in a pyrimidine. Which type of transfer process and the specificity of localization in enzymes and how these may contribute to inactivation is still uncertain. (85 references). (auth)

26846 EFFECTS OF RADIATION ON NUCLEIC ACID METABOLISM: A REVIEW OF CURRENT CONCEPTS. Oddvar F. Nygaard (Western Reserve Univ., Cleveland). p.47-73 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

Some of the literature concerning the effects of ionizing radiation on nucleic acid metabolism is reviewed. The conclusion is made that the synthesis of DNA per se is not very sensitive to irradiation, but that the replication of DNA in the cell may be more readily inhibited or delayed as a result of interference with other processes of the cell cycle. The synthesis of nuclear RNA appears to be inhibited by irradiation in certain cases. A relationship between this inhibition and damage inflicted on the DNA macromolecule has been suggested. The effect of radiation on other aspects of the metabolism of the cell nucleus has been discussed briefly. (88 references). (auth)

26847 EFFECT OF IONIZING RADIATIONS ON THE STRUCTURE AND REACTIVITY OF PROTEINS. Peter Alexander (Chester Beatty Research Inst., London). p.75-98 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

When proteins are exposed to ionizing radiation in the solid state the most marked effect is that the secondary structure is disrupted and this is responsible for the inactivation of enzymes. This denaturation is believed to be due to the disruption of hydrogen bonds as a result of an ionization and not the consequence of the covalent chemical changes which also follow on ionization. Radiation initially produces a very heat labile state which has not been obtained with other denaturing agents. One of the consequences of irradiation is that reactive side chains which are sterically inaccessible in the native protein become available for reaction. These include SH groups; —S—S— groups and $—NH_2$ groups. Conversely some groups that are accessible in the native protein become inaccessible in the irradiated protein. These effects have been observed in serum albumin, serum γ-globulin, lysozyme and trypsin. With wool fibres the extensive rupture of hydrogen bonds has been demonstrated by mechanical tests. Radiation induced covalent changes lead to the introduction of new groups such as —CO and unusual side chains due to decarboxylation of aspartic and glutamic acid residues. The chemical behavior and general reactivity of the irradiated protein is therefore very different from that of the starting material. Although the different amino-acid residues vary in their radiosensitivity, there is no pronounced effect due to energy transfer. Electron spin resonance measurements have shown that the deduction that most of the energy is transferred to the sulfur atoms is incorrect. In the dry state there is a pronounced oxygen effect with sparsely ionizing radiations. The increased inactivation is believed to be due to peptide bond scission which plays no part in the absence of oxygen. Breakage of secondary valency bonds is not enhanced by oxygen. Reasons are given why this oxygen effect is thought to be due to the formation of O_2^- radicals. The changes produced when proteins are irradiated in solution are largely the result of covalent chemical alterations in the side chains. Most of the amino-acid residues seem to be attacked if sparsely ionizing radiations are used and there is no great selectivity. New groups such as —CO and peroxides are also introduced. An important reaction which is liable to affect the reactivity is the formation of stable covalent cross-links between molecules. Denaturation can also be detected, for example, by revelation of disulphide bonds, but this in contrast to direct action, would appear to be a consequence of the rather extensive covalent chemical changes. If protein solutions are irradiated with α-rays, the changes produced are qualitatively different from those produced by sparsely ionizing x rays. The attack is not largely confined to the tryptophane residues. It has been postulated that in the densely ionizing track a reactive form of hydrogen peroxide is formed which reacts differently from OH radicals. (25 references). (auth)

26848 ENERGY REQUIREMENTS FOR INACTIVATION OF PROTEINS AND VIRUSES. Dwight E. Wilson (Rensselaer Polytechnic Inst., Troy, N. Y.). p.99-113 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

Radiation inactivation studies on proteins in the solid state have shown that the release of energy equal to approximately one ionization in a molecule will cause inactivation. The radiosensitivity of proteins is, however, dependent to a certain extent on the physical conditions, such as temperature and oxygen tension during irradiation, and the chemical environment of the molecules. Radiation studies indicate that virus particles contain a radiosensitive component which is generally much less massive than the virus particle, and that one ionization in this component will cause inactivation. A linear relationship between nucleic acid content and radiosensitivity exist for plant and bacterial viruses, but not for animal viruses. For the animal viruses containing RNA, the radiosensitive mass is equal to or greater than the nucleic acid mass, while for the DNA viruses the radiosensitive mass is smaller than the nucleic acid mass. It is concluded that the RNA animal viruses contain radiosensitive protein, and that the DNA animal viruses contain both radiosensitive protein and radioinsensitive nucleic acid. (44 references). (auth)

26849 EFFECTS OF IONIZING RADIATIONS UPON THE SEROLOGICAL PROPERTIES OF PROTEINS. Charles A. Leone (Univ. of Kansas, Lawrence). p.115-61 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

Both in vivo and in vitro analyses of γ-irradiated proteins indicate that the principal effect of the radiation

is to cause a loss of the normal biological activity of the affected molecules. Comparisons are presented of the anaphylactogenic, preceptin stimulating, and serologic properties of native and irradiated ovalbumin. Presented also are serologic comparisons of native and irradiated samples of human gamma globulins and arthropod hemocyanins. (32 references) (auth)

26850 EFFECTS OF RADIATION ON CELL PHYSIOLOGY, CELL DIVISION AND CELL DEATH. Alma Howard (Mount Vernon Hospital, Northwood, Middx., Eng.) p.163-80 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

The effects of radiation on cell physiology, cell division, and death of mammalian cells are discussed with emphasis on the influence of the time relationships of irradiation and antigenic stimulus. The similarity of radiosensitivity shown by a number of different types of mammalian cells and the loss of reproductive integrity in irradiated cells are considered. It is postulated that the effects of irradiation on immune processes are unlikely to be due to a direct interference by radiation in those metabolic processes or activities that are already being carried out at the time of irradiation. Since the formation of a new enzyme system is a highly radiosensitive process, if this is the mechanism through which antibody production is initiated, the radiosensitivity of antibody production is to be expected. If antibody production depends upon cell proliferation, it is to be expected that moderate radiation doses will cause antibody reduction. (36 references) (C.H.)

26851 RADIATION EFFECTS ON PRIMARY AND SECONDARY ANTIBODY RESPONSES. Richard D. Stoner (Brookhaven National Lab., Upton, N. Y.) and William M. Hale. p.183-219 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962. (BNL-5657)

A short term exposure of 400 rads repressed the primary antitoxin response in mice elicited with fluid tetanus toxoid and effected an initial repression followed by a typical primary response when adsorbed tetanus toxoid was used for the primary immunization. Radiation doses of 50 to 300 rads increasingly depressed the primary response to fluid toxoid, whereas doses of 300, 400, and 600 rads were needed to produce a corresponding depression of the specific anamnestic reaction. A comparison of doses required to produce 50 per cent depression of both responses indicated that the primary response was about three times more radiosensitive than the secondary response. An immediate radio-sensitivity of the primary response was obtained when the primary stimulus of fluid toxoid was given one and three hours after exposure to 200 rads while a delay of six to twelve hours in the injection of fluid toxoid was required to produce a similar repression of the secondary response. A dose of 625 rads completely repressed the primary response to fluid toxoid given within a post-radiation period of 21 days. A significant recovery in the ability to elicit a primary response to adsorbed toxoid was obtained during the second and third week after irradiation. A similar recovery period was found for the secondary response elicited with fluid toxoid. Primary and secondary antitoxin responses were not significantly repressed when doses as high as 650 to 800 rads were delivered four days after the primary or secondary antigenic stimulus of fluid toxoid. Continuous exposure at a dose rate of 4.1 rads per hour to accumulated doses of 25 and 50 rads effected a slight depression of the primary response. A similar depression of the secondary response was found with accumulated doses of 50 and 100 rads. When we compare 50 per cent reduction of the normal responses, the primary response appears to be about three times more radiosensitive than the secondary response. Preparations of HeLa cells, HeLa cell extract and Zymosan failed to restore the ability to produce antitoxin in irradiated mice when these preparations were given one day after irradiation and fluid toxoid was injected on the following day. (24 references) (auth)

26852 THE EFFECTS OF PROLONGED IRRADIATION ON THE IMMUNE RESPONSE. Laurence R. Draper (National Cancer Inst., Bethesda, Md.). p.221-44 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

Recovery during prolonged irradiation reduces the effectiveness of a given dose of ionizing radiation. Evidence is presented which suggests that the mechanisms of hemolysin formation respond to prolonged, low-level irradiation with a reapportionment of the contribution of the different sites of antibody synthesis to the antibody response. (244 references) (auth)

26853 RESPONSES OF DISEASED ANIMALS TO IONIZING RADIATION. David M. Donaldson (Brigham Young Univ., Provo, Utah). p.245-68 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

When the depression of host defenses was studied in relation to the period of minimum resistance which follows irradiation injury it was observed that the decrease in number of the circulating granulocytes, phagocyte killing activity, the phagocyte digestive capacity, and bactericidal activity of rabbit serum against Gram-positive bacteria took place at times when the resistance of the animal was low. It is questionable whether a correlation exists between the resistance to infection in the irradiated animal and the serum bactericidal activity against the Gram-negative organisms, the phagocyte's ability to migrate or the ability of the mucosa of the nasopharynx to resist bacterial invasion. No correlation existed between resistance to infection and damage of the gastrointestinal tract or changes in the engulfing activity of the fixed phagocytes. (78 references) (C.H.)

26854 EFFECTS OF RADIATION ON NATURAL IMMUNITY AND WAYS OF ITS STIMULATION. Victor L. Troitski (Gamaleya's Inst. of Epidemiology and Microbiology, Moscow). p.269-78 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

Among the numerous factors of natural immunity destroyed by irradiation, suppression of hemopoiesis plays an especially important role. Hemopoiesis is connected with phagocytosis and antibody production. These are two mechanisms of protection which provide the normal immune stability of the internal environment of the organism in the usual situation of constant assault by microorganisms on the body from the time of birth. Among different ways of simultaneously stimulating myelogenesis and natural immunity in irradiated animals, the transplantation of bone-marrow cells from non-irradiated donors is of especial interest. The great difficulty in using bone-marrow cell transplantation as a therapeutic tool is in the secondary reactions, which are connected with the mutual incompatibility of tissues. Some methods of overcoming transplantation immunity and secondary reactions in the irradiated animals treated with bone-marrow include multiple injection of the bone-marrow cells, artificial extramedular production of myeloid tissue, and

the use of cortisone. The participation of anaphylactic antibodies in transplantation immunity indicates the possibility of using immunological methods for the treatment of runt disease. (19 references) (C.H.)

26855 INFLUENCE OF PREIRRADIATION AND POST-IRRADIATION TREATMENT WITH PHARMACOLOGICAL AGENTS ON IMMUNITY IN ANIMALS. Hanns Langendorff (Universitat, Freiburg i B.). p.281-99 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

Fundamentals of radiation biology are reviewed from the standpoint of the effectiveness of various pharmacological agents in the treatment of radiation injuries. Factors influencing the selection of protective chemicals are considered. Reaction mechanisms are discussed that are involved in the protection against radiation injuries afforded by sulfur-containing compounds such as cysteine or cysteamine; pharmacologically active substances such as cyanide, serotonin, or tryptamine; metabolites such as glucose or pyruvic acid; compounds with specific protective characteristics such as thiourea; and vitamins and hormones. Substances of proven usefulness in protection against radiation damage are listed. It is pointed out that while experiences in the field of radiation prophylaxis are already very extensive and the ideas about the reaction mechanism of protective agents have a physiological basis, at present no chemicals have been found that are as effective for postirradiation therapy as transplanted bone marrow cells or embryonic tissue. (27 references) (C.H.)

26856 RESTORATION OF HEMOLYSIN-FORMING CAPACITY IN IRRADIATED RABBITS AND ITS RELATION TO INDUCTION OF ANTIBODY SYNTHESIS. Bernard N. Jaroslow and William H. Taliaferro (Argonne National Lab., Ill.). p.301-14 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

Suppression of the hemolysin response in rabbits is maximum when the antigen (sheep red cells) is injected 12 to 24 hours after whole-body x irradiation. At 400 r the loss of antibody-forming capacity is 90 to 95%. If one of a number of preparations is injected at the same time as the antigen, the hemolysin-forming capacity is restored to varying degrees. Because of the activity or lack of activity of the various agents tested, we have concluded that the induction of antibody synthesis is associated with and occurs at the time of DNA synthesis. (27 references) (auth)

26857 EFFECTS OF NONSPECIFIC AGENTS ON ANTIBODY RESPONSE IN IRRADIATED ANIMALS. Hans-Stephan Stender (Phillips Univ., Marburg, Ger.), Dieter Strauch, and Horst Winter. p.315-34 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

The primary antibody response in rats to Brucella antigen was affected to varying degrees by irradiation depending upon the dose of antigen and the dose of x rays, and the time sequence between the two. The response was most markedly depressed when the antigen was given 1 to 2 days after x rays. To study further this maximal damage of x rays on the antibody response, we injected Brucella antigen 2 days after moderate (200 to 350 r) or large (500 r) amounts of x rays in conjunction with the injection of various nonspecific substances before or after the x rays. These test-substances were proteins of Escherichia coli, insoluble polysaccharides of yeast, cells, a sterile suspension of carbon, or china clay. The antibody response, when the test-substances were injected at 8 and 3 days before moderate irradiation of rats, resembled the antigen control rather than the irradiated control response, whereas the response, when the test substances were injected similarly before heavier dose of x rays was intermediate in intensity between those the antigen control and irradiated control responses. Spleen transfers, from irradiated donor rats injected similarly with the nonspecific substances to irradiated recipient rats, also showed a protective effect when taken from the donor rats 2 days after the injection of antigen. The antibody responses, when the test-substances were injected 1 hour after moderate irradiation and 2 days before antigen, were not diminished. On the other hand, the test-substances, when injected 1 or 2 days after irradiation, did not protect rats. Antibody responses were similar to those of irradiated controls and lower in intensity with a longer induction period than the responses of nonirradiated controls. Cytological and histological investigations, and autoradiographic studies using H^3-thymidine revealed that the nonspecific agents caused an activation of the lymphoreticular tissue. When the nonspecific agents were given a week or so before irradiation or even a few hours after irradiation, lymphoid reticulum cells were activated. The activated cells were relatively radioresistant. They were immediately induced by antigen and then developed at the normal rate into antibody-producing cells. (29 references) (auth)

26858 PARTIAL BODY IRRADIATION AND ANTIBODY RESPONSE. Dieter H. Sussdorf (California Inst. of Tech., Pasadena). p.335-61 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

The protection of the antibody response by shielding a tissue during body irradiation does not necessarily depend on the participation of the shielded site in antibody synthesis. Shielding of a site such as the appendix, which is normally not involved in the antibody response, results in the preservation of lymphoid cells which can repopulate the radiation-damaged sites of antibody formation, thus causing an accelerated recovery of the animal's antibody-forming capacity. If a site such as the spleen, which is an important contributor to the antibody response to particulate antigens, is protected, a dual effect results: the preservation of local antibody-forming capacity and the preservation of cells capable of repopulating radiation-damaged tissues. Selective x irradiation of an organ such as the spleen with large doses probably creates an environment rich in cellular degradation products (which have been shown to stimulate cell proliferation) resulting from the destruction of lymphocytes. When this environment is encountered by a sufficient number of implanting cells from the shielded body, an enhanced antibody response may result in the presence of antigen. It appears, then, that two factors which influence the antibody response in partially irradiated animals are the degree of cell destruction and the resulting accumulation of cellular degradation products in exposed tissues which normally contribute to the antibody response, and the degree of repopulation of these tissues by mobile cells of the protected areas. (45 references) (auth)

26859 A GENETIC AND IMMUNOLOGIC APPROACH TO THE PURIFICATION OF AN HISTOCOMPATIBILITY ANTIGEN. Leonard A. Herzenberg (Stanford Univ., Palo Alto, Calif.). p.365-79 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

The H-2 antigen is the only one of the mouse histo-

compatibility antigens that can readily be detected on red blood cells by hemagglutination with isoantisera. The presence of an H-2 antigen on cells other than erythrocytes, or in purified tissue fractions, can be demonstrated by incubating these materials with appropriate isoantiserum and observing the decrease in hemagglutinin titer when the absorbed serum is then tested with the corresponding red cells. Progress is reported in the purification and concentration of H-2 antigen. The possibilities of using this material to induce graft tolerance in H-2 IR strain mice are discussed. (29 references) (C.H.)

26860 GENOTYPES AND BONE MARROW TRANSPLANTATION. Gustavo Hoecker, Fernando Morgado, Alicia Ramos, and Olga Pizarro (Univ. of Chile, Santiago). p.381-401 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

The relationship of genetically controlled antigenic individuality of bone marrow and of the recipient on the outcome of bone marrow transplants in irradiated animals are discussed. The differences at specific H-loci in mice were analyzed and results are reported. (41 references) (C.H.)

26861 RADIATION IMMUNOLOGY: EFFECTS OF HEMATOPOIETIC TISSUE TRANSPLANTATION. N. Gengozian (Inst. of Nuclear Studies, Oak Ridge, Tenn.). p.403-54 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

Results are reviewed from recent studies on radiation immunology with emphasis on effects of genetic factors on results in hematopoietic tissue transplantation. Topics discussed include immunology in radiation chimeras, immunologic studies in irradiated animals treated with isologous tissue, immunologic recovery of isologous-radiation chimeras, immunologic reactions in foreign-tissue radiation chimeras, immunologic interpretations of the secondary disease syndrome, immunologic mechanisms of foreign-tissue chimeras, and the immunologic status of foreign-tissue chimeras. (144 references) (C.H.)

26862 RADIATION MICROBIOLOGY AND IMMUNOLOGY IN THE U.S.S.R. A BRIEF REVIEW OF THE LITERATURE. Julian Hoptman (George Washington Univ., Washington, D. C.). p.455-503 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962.

A brief review is presented of recent Soviet literature in the field of radiation microbiology and immunology. Topics covered include infections processes; natural immunity; antibody formation and production; microbiological processes; and serums, proteins and amino acids. (190 references) (C.H.)

26863 THE EFFECTS OF PROLONGED DAILY IRRADIATION ON THE NUCLEIC ACID METABOLISM IN CERTAIN RABBIT TISSUES. R. Ye. Libinzon and V. V. Konstantinova. p.18-28 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

Studies were made on the effects of gamma radiation at 0.7 r/min 6 times a week on the ribonucleic acid content in the bone marrow and liver in rabbits. The results are presented in the form of arithmetical means and mean errors. No great changes in the content of RNA and DNA acid phosphorus in the liver were noted. In the first few days of irradiation the content was reduced, but rose slightly as irradiation continued, returning to normal at a total dose of 2490 r. The synthesis of RNA and DNA in the liver rose slightly at the beginning of irradiation and tapered off as radiation continued. In the bone marrow the RNA acid content showed no great changes after 7 irradiations, but continued irradiation led to a marked drop. At 2490 r the content was somewhat increased. The animals survived all irradiation up to and including a total dose of 2490 r. This is attributed to the fact that fractionation of the radiation dose greatly reduces its biological effect. Prolonged irradiation accelerated the inclusion of P^{32} into the RNA of both the liver and the bone marrow; this was generally accompanied by an increase in the number of dividing cells. Disturbance of the normal coordination between DNA synthesis and cell division led to the formation of cells containing a hyperploid quantity of DNA. Prolonged irradiation caused substantial changes in both liver and bone marrow, although the synthesis of DNA and RNA was more inhibited in the liver. On the other hand, destructive processes were more marked in the bone marrow. This was probably due to the greater intensity of cell division in the latter. The formation of the hyperploidal cells is regarded as a mechanism of adaptation. (OTS)

26864 CHANGES IN THE BLOOD SYSTEM OF RABBITS WITH MULTIPLE REPEATED EXTERNAL GAMMA-IRRADIATION. L. V. Bogatov and N. A. Koshurnikova. p.29-37 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

Hematological and cystological examinations of the hemopoietic organs of rabbits was made after repeated multiple gamma irradiation. The rabbits were killed off after total doses of 210, 420, 630, 900, 1410, 1920, and 2490 r. A detailed account of the changes in the bone marrow, spleen, and lymph nodes is given. The changes can be broken down into 3 periods. Period I, from the start of irradiation until a dose of 630 r, changes in the peripheral blood and the hemopoietic organs increase. The inhibition of granulocytopoiesis and thrombocytopoiesis in the peripheral blood and the inhibition of lymphopoiesis in the spleen and lymph nodes are accompanied by a rise in leukopenia and thrombopenia in the peripheral blood. The red blood does not change. After a dose of only 60 r relative hyperplasia of the red growth begins. Period I is therefore the period of primary reactions, marked by early simultaneous onset of changes in erythropoiesis and leukopoiesis, inhibition of the white growth, and hyperplasia of the red. Period II, from 900 r to 1410 r, is first marked by a sharp drop in the absolute number of erythropoietic cells, followed by stabilization on a low level. The number of nucleus-containing cells in the bone marrow fell to 33% of normal. Mitotic activity was greatly inhibited in both the marrow and the lymphopoietic organs. The lack of rising blood system changes in this period indicates that the rabbits were adapting to the rhythm of irradiation; new reparative processes apparently developed under the protracted irradiation. Period III, from 1920 to 2490 r, is marked by relative normalization of the hemopoietic organs' quantitative composition; total cellularity increases to 66% of normal, as opposed to 33% in period II. Mitotic activity increases and the number of erythroblastic cells rises more intensively. Under protracted irradiation qualitatively new cells, capable of division, can apparently emerge. In both the red and the white blood of the marrow, spleen, and lymph nodes cell regeneration proceeds normally, but with greater mobilization of deep reserves of hemopoiesis, as is indicated by the increase in the number of reticular cells. The main preference is for erythropoietic regeneration, as the most important process for the continuation of life. (OTS)

26865 A STUDY OF THE FUNCTIONAL STATE OF THE BLOOD SYSTEM IN DOGS AT REMOTE DATES AFTER THE CHRONIC ACTION OF IONIZING RADIATION. L. V. Bogatov and Z. I. Kalmykova. p.38-48 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

Tests were carried out on 4 groups of dogs, using the functional loading system. Group I received chronic gamma irradiation at 10 r/day to a total dose of 1300 r, group II received 4 shots of plutonium nitrate into the blood in a dose of 0.05 μC/kg (total dose 0.2 μC/kg), group III received combined external gamma irradiation and plutonium nitrate, and group IV received chronic external gamma irradiation at 18 r/day to a total dose of 954 r. The functional loads were: massive single blood-letting; intramuscular injection of skimmed milk and adrenalin; and 10 blood-letting sessions. In both test and control dogs the peripheral blood reaction to milk was marked neutrophilic leukocytosis with a stabnuclear shift. The reaction to single blood-letting was also the same in both test and control dogs, although blood restoration after the blood-letting returned to normal more quickly in the test than in the control animals, probably because the former had a more extensive basis for erythropoiesis. After 10 blood-letting sessions the erythrocyte and hemoglobin count dropped in all animals. The erythrocyte count returned to normal 21 days after the end of blood-letting in all dogs with the exception of those in group III (32 days). Symptoms of microplanocytosis were noted in groups II and IV in the latter part of the blood-letting period. In group I changes in the size of the erythrocytes due to blood-letting generally followed those in the control animals, but the tendency to spherocytosis was more marked in the former. The results indicate that the reaction of the peripheral blood to repeated blood-letting was essentially the same in both test and control animals. At remote stages after ionizing irradiation the functional activity of the dogs' hemopoietic organs was on a high level. The inhibition of leukocytosis in the milk test and repeated blood-letting, the later appearance of reticulocytosis in the latter, the presence of microcytosis, retardation of blood coagulation, leukopenia, and thrombopenia after repeated loss of blood--all indicate that full restoration of the hemopoietic system and the body's functional activity does not occur in every case, but depends largely on the time that has elapsed since chronic irradiation. (OTS)

26866 THE COURSE OF BONE TISSUE LESIONS IN RABBITS CONTAMINATED WITH PLUTONIUM-239. Z. M. Bukhtoyarova. p.155-63 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

Studies were made on the effects of incorporated Pu^{239} on the bone tissue of rabbits, the normal growth of whose skeleton ceases by the end of the animal's first year of life. Plutonium was injected into 6-8-month-old rabbits intravenously as $Pu(NO_3)_4$ in single doses of 21, 14, 7, and 2 μC/kg. Some rabbits were killed after 15 days, 1, 3, 6, 7, and 12 months. The rest were spared to determine their life duration and the rate of osteosarcomogenesis at later stages. Doses of 21, 14, and 7 μC/kg greatly reduced the animals' life span and induced marked lesions of the peripheral blood and a pronounced drop in body weight. A drop in the leukocyte count was noted after 5-15 days and was not restored to normal in the rest of the animals' life span. The dose of 2 μC/kg caused no substantial lesions of the peripheral blood but somewhat reduced the animals' life span. In animals killed 15-30 days after a dose of 7 μC/kg, thickened atypical beams were noted in the epiphysometaphysical area of the hipbone. By the 3rd month the number of mitoses in the lamellar cells and the osteoblast count both showed a marked drop, whereas the osteoclast count had risen sharply. Varying degrees of aplasia of the bone marrow and replacement of bone marrow cells by fibrous tissue was noted in all animals killed from the 15th day onwards. Despite the predominance of resorption processes (osteolysis), bone neoplasms (often atypical) were noted in some rabbits. About 50% of the rabbits which received 2 μC/kg developed bone tumors; these animals mostly died at the age of 1 year. The tumors were identified as osteogenic sarcomata, mainly of the osteoplastic type. The destruction of the bone tissue in rabbits which received 7, 14, and 21 μC/kg far exceeded normal bone changes due to age. These lesions corresponded to the pathoanatomical picture of typical acute and subacute radiation sickness from isotopes of the osteotropic group. Comparison of the reactions of rabbits and rats at 7 and 2 μC/kg showed that the former are more sensitive to the action of plutonium. Both doses reduced the rabbits' life more than that of the rats. The 2 μC/kg dose induced osteosarcomata in 50% of the rabbits, while a dose of 1.89 μC/kg induced tumors in only 30% of the rats. (OTS)

26867 THE HISTOPATHOLOGY OF THE SEX GLANDS IN RABBITS AFFECTED BY INCORPORATED PLUTONIUM. N. A. Koshurnikova. p.164-73 of "Biologicheskoye Deystviye Radiatsii i Voprosy Raspredeleniya Radioaktivnykh Izotopov; Sbornik Rabot." Moscow, Gosatomizdat, 1961.

A study was made of the histopathology of the sex glands in rabbits affected by incorporated plutonium at both near and remote dates after the isotope entered the body. $Pu(NO_3)_4$ was injected intravenously in the following doses: group I--21, group II--14, group III--7 and group IV--2 μC/kg. Groups I and II sustained acute and subacute radiation sickness and mainly died of aplasia of the bone tissue. Groups III and IV showed symptoms of radiation sickness. Group III animals died mainly of cirrhosis of the liver and group IV animals of osteosarcomata. Histological examination showed that part of the plutonium was retained in the connective structures of the sex glands. The incorporated plutonium led to a whole series of pathomorphological lesions which broadly consisted in the damage and death of the parenchymatous elements of the testes and ovaries. The degree of illness varied with the dose of plutonium and the time which had elapsed since its injection. In the early stages the main role in the development of pathological lesions of the sex glands is played by the direct action of radiation; at later stages the general state of the body is of prime importance. The changes in spermatogenesis were of a phase nature: inhibition phases alternated with phases of restoration. Spermatogonia were restored by the undifferentiated cells of the sperm ductules. In the ovaries restoration apparently did not occur under the constant radiation from the incorporated plutonium. (OTS)

Radiation Sickness

26868 (AF-SAM-62-29) A SURVEY OF COMPOUNDS FOR RADIATION PROTECTION. John Doull, Vivian Plzak, and Stanley J. Brois (Chicago. Univ. Air Force Radiation Lab.). Sept. 18, 1961. 124p.

Issued by School of Aerospace Medicine, Brooks AFB, Tex.

Results are presented for 1200 compounds tested before January 1, 1961, that exhibit prophylactic or therapeutic

effectiveness against radiation injury. The toxicity of each compound is also presented. (N.W.R.)

26869 (USNRDL-TR-571) HOMOLOGOUS BONE MARROW TRANSPLANTATION IN DOGS RECEIVING X RADIATION PLUS URETHANE OR 6-MERCAPTOPURINE. L. J. Cole and E. L. Alpen (Naval Radiological Defense Lab., San Francisco). July 19, 1962. 36p.

Studies were made on homologous marrow transplantation in 13 mongrel dogs (Group 1) treated with 6-mercaptopurine (6-MP) or urethan prior to x irradiation (900 r, delivered at a dose rate of 15 r/minute). The marrow dose was 7 to 11 $\times 10^9$ cells, given on the day following irradiation; urethan (175 or 350 mg/kg) and 6-MP (12.5 or 25 mg/kg) were administered at 3 or 4 daily intervals during the week prior to irradiation. Mean survival time (MST) in Group 1 was 23 days, with a maximum of 63 days. MST in a group of dogs (Group 2) given homologous marrow after 900 r, but not treated with the chemicals, was 10 days. Group 1 characteristically showed good recovery of peripheral blood granulocyte count by 8 to 10 days, together with objective evidence of marrow take; recovery of mononuclear cell count was not observed, except in the single case which survived for 63 days. None of Group 2 showed any rise in the peripheral blood count after initial depression, and all died with marrow aplasia. Secondary disease in Group 1 was characterized by anorexia weight loss, infection, and lymphoid tissue aplasia in all the animals; skin atrophy, liver lesions, jaundice, and anemia were seen in some of the animals. The marrow showed active hematopoiesis and moderate to good cellularity in most of Group 1, although megakaryocyte activity was deficient in some. Pneumonia and pulmonary edema were found in many of the dogs, at autopsy. It is evident that the use of these antimetabolites permits the successful transplantation of homologous marrow in dogs at a dose of x radiation (900 r) which, by itself, is insufficient. These compounds (urethan and 6-mercaptopurine) are, therefore, additive to x radiation with respect to suppressing the homograft reaction in dogs, as well as in mice. (auth)

26870 STUDIES ON RADIOPROTECTION OF VARIOUS COMPOUNDS IN VITRO AND IN VIVO. Annelies Schleich (Univ. of Heidelberg). Ann. N. Y. Acad. Sci., 95: 1009-20 (Nov. 13, 1961).

The responses of mice and of a strain of human fibrosarcoma were compared in a general way following irradiation. An attempt was made to detect protection with a series of compounds. The best results have been obtained with cysteine and cysteinamine. The great variety of our objects gave us results on a broad spectrum. It is not our intention to try to compare these results beyond a certain level; however we hope to be able to add some fragments to the big mosaic of experiments on radioprotection. (auth)

26871 TOXIC AND PROTECTIVE EFFECTS OF AET UPON NORMAL AND IRRADIATED FEMALE RATS. George S. Melville and Thomas P. Leffingwell (USAF Aerospace Medical Center (ATC), Brooks AFB, Tex.; Univ. of Texas, Austin; and U. S. Air Force, Austin, Tex.). Brit. J. Radiol., 35: 563-71(Aug. 1962).

The toxicity and pathologic effects of acute doses of AET-DiBr were examined in rats. The compound is highly toxic to rats, but only local pathological change has been observed. The chronic effects of AET-DiBr have been examined by means of serial intraperitoneal injections. At low doses, large total amounts of the drug can be tolerated. Significant protection against ionizing radiation from Co^{60} was demonstrated in female rats given the drug AET. AET is a more effective radioprotectant when given by intraperitoneal injection than when administered orally. In orally-treated animals, a radiation dose-rate effect has been observed. AET affords less protection to animals irradiated at lower dose-rates. (auth)

26872 GRAFTS OF BONE MARROW AFTER WHOLE BODY IRRADIATION IN LEUKEMIC MICE FOLLOWING THE ADMINISTRATION OF AN ANTIMITOTIC TO REDUCE THE FREQUENCY OF THE SECOND SYNDROME AND TO ADD TO ANTILEUKEMIC EFFECT. Georges Mathe, Jean-Louis Amiel, and Julien Niemetz (Hopital Saint-Louis, Paris and Institut Gustave-Roussy, Villejuif, Seine, France). Compt. rend., 254: 3603-5(May 14, 1962). (In French)

In a study of the effect of bone marrow grafts on irradiated animals, hybrid mice F_1(C57 Bl/6 $\times$ DBA/2) received 10^3 cells of L 1210 leukemia and a radiation dose of 850 r. Animals treated with bone marrow grafts received 10^7 cells four hours after irradiation. Amethopterine and cyclophosphoamide at doses incapable of eradicating leukemia were used as antimitotics. The results tabulated show that the use of the antimitotic alone, as well as irradiation at a lethal dose followed by isogenic hematopoietic grafts, have a positive but weak antileukemic effect. Irradiation followed by semi-allogenic hematopoietic graft has a much sharper antileukemic effect, but animals died of the secondary syndrome. An attempt is made to interpret the results obtained in the case of animals receiving whole-body irradiation, bone marrow grafts, and antimitotic treatment. (J.S.R.)

26873 SEROTHERAPEUTIC TREATMENT OF CUTANEOUS RADIOLESIONS IN THE RAT. Jean Loiseleur, Liliane Catinot, and Annik de Vomecourt. Compt. rend., 254: 3609-10(May 14, 1962). (In French)

The restoration factor appearing in the radio-vaccinated rat can be transmitted by injecting the serum of this rat into a new born animal exposed to radiation. This serum, injected the fifth day after irradiation, exercises a curative effect on the radiolesion. (tr-auth)

26874 PROLONGED SURVIVAL OF SKIN HOMOGRAFTS IN ADULT MICE FOLLOWING SUB-LETHAL IRRADIATION, INJECTION OF DONOR-STRAIN SPLEEN CELLS AND ADMINISTRATION OF A-METHOPTERIN. M. F. A. Woodruff (Univ. of Edinburgh, Eng.). Nature, 195: 727-8(Aug. 18, 1962).

Sixteen A-strain male mice were given 500 r whole-body irradiation, followed by an intravenous injection of 150 million nucleated spleen cells from male CBA mice twice daily for two days, starting on the day of irradiation. Four mice received no further treatment; the remainder were given A-methopterin in a dosage of 1.5 μ g/g body-weight every 2 days for six doses, starting 2, 6, or 10 days after irradiation. Four weeks after irradiation all surviving mice received a homograft of skin from a CBA male donor. The incidence of fatal graft-versus-host disease was greatly reduced by administration of A-methopterin starting on day 2, and reduced to a lesser extent by administration of the drug starting on day 6. (P.C.H.)

26875 THE EFFICACY OF CHEMOTHERAPY IN RADIATION SICKNESS CAUSED BY FRACTIONAL RADIATION. E. K. Dzhikidze and A. S. Aksenova (Inst. of Experimental Pathology and Therapy, AMS USSR). Zhur. Mikrobiol., Epidemiol. i Immunobiol., No. 10, 11-16(1961).

Studies were conducted in order to find out whether it is possible, with the aid of chemotherapeutic preparations, to prevent the development of bacteremia in animals repeatedly subjected to small doses of ionizing irradiation. The solution of this problem would also make it possible

to explain what significance the infectious agent has during radiation sickness caused by fractional irradiation. Nineteen $1\frac{1}{2}$ to 2 years-old monkeys, all carriers of Flexner's bacilli, were subjected to daily gamma irradiation in fractional doses (25.2–26.34 r) from a Co^{60} source up to a total dose of 1000 r. After a 650 r dose had been administered, the monkeys were separated into two groups. Nine of them were treated with antibiotics in combination with vitamins, while the other ten served as controls. The animals were treated for one month. The monkeys were given, simultaneously, 50000 U streptomycin and 100,000 U penicillin intramuscularly, and 50000 U streptomycin and 0.25 g levomycetin orally. Besides antibiotics, once daily the monkeys were treated with 0.1 g vitamin C, 0.5 ml of a 5% vitamin B_1 solution injected intramuscularly and 5 ml of a 10% calcium gluconate solution taken intravenously. After a short time symptoms of a developing radiation sickness appeared. Changes in the peripheral blood of two monkeys are discussed. The chemotherapeutical results show that the combined administration of antibiotics in radiation sickness in monkeys caused by fractional radiation gives a high therapeutic effect and favors the survival of the majority of the animals irradiated with 1000 r. (OTS)

CHEMISTRY

General and Miscellaneous

26876 (TID-16290) NUCLEAR CHEMISTRY RESEARCH AT CARNEGIE INSTITUTE OF TECHNOLOGY 1961–1962. Progress Report. (Carnegie Inst. of Tech., Pittsburgh). June 1, 1962. Contract AT(30-1)-844. 92p.

Progress in nuclear chemistry research activities is reported. Nuclear reactions, geochemistry, and cosmochemistry were studied. (M.C.G.)

26877 FORMATION OF A DEUTERIDE PHASE IN THIN NICKEL LAYERS. A. Stroka and B. Baranowski (Inst. of Physics and Chemistry, Polish Academy of Sciences, USSR). Bull. acad. polon. sci., Ser. sci., Chim., 10: 147-52(1962). (In English)

Studies were made on Ni layers charged with cathodically evolved D_2. When the D_2 charging was carried out repeatedly in 0.5 N D_2SO_4 in D_2O, the Ni layers were charged uniformly to a depth of only 8μ with a D/Ni atomic ratio of 0.76, showing that it is more difficult to charge Ni with D_2 than with H_2. A modification of the charging procedure to include preliminary charging with H_2 and washing with D_2O increased the penetration of D_2 into Ni. Measurements of desorbed D_2 and H_2 from Ni layers previously charged to maximum D_2 or H_2 content show that a maximum of 97.7 ± 4.6 cm^3D_2 was absorbed to a depth of 24.5 μ, as compared with 114 ± 4.0 cm^3H_2 at a depth of 29.5 μ. (D.L.C.)

26878 THE HYDROGEN ISOTOPE EFFECT IN THE PYROLYSIS OF ETHYL-1,1,2,2-d_4 CHLORIDE. Arthur T. Blades, P. W. Gilderson, and M. G. H. Wallbridge (Research Council of Alberta, Edmonton, Can.). Can. J. Chem., 40: 1526-32(Aug. 1962).

The hydrogen isotope effect in the pyrolysis of ethyl-1,1,2,2-d_4 chloride has been investigated in the temperature range 758 to 989°C, yielding the relative rate constant expression $k_H/k_D = 1.16 \exp(985 + 50/RT)$, where k_H and k_D are the rate constants for the production of C_2D_4 (and HCl) and of C_2D_3H (and DCl) per β-deuterium atom, respectively. The isotope effect is pressure dependent, its value increasing with decreasing pressure. The pressure effect in ethyl chloride has also been studied, and a qualitative explanation is given for the pressure dependence of intermolecular and intramolecular isotope effects. The data are compared with the isotope effects in ethyl-d_5 acetate, and the conclusion is reached that the evidence supports a four-centered transition-state complex in the case of the halides. (auth)

26879 THE HYDROGEN ISOTOPE EFFECTS IN THE PYROLYSIS OF ETHYL-1,1,2,2-d_4 BROMIDE AND OF ETHYL-d_5 BROMIDE. Arthur T. Blades, P. W. Gilderson, and M. G. H. Wallbridge (Research Council of Alberta, Edmonton, Can.). Can. J. Chem., 40: 1553-39(Aug. 1962).

The relative rate constant expression has been obtained for the decomposition of ethyl-1,1,2,2-d_4 bromide under inhibiting conditions in the temperature range 697.6 to 999.1°K, $k_H/k_D = 1.18 \exp(925 + 50/RT)$. The pressure dependence of the isotope effect has been investigated both with and without inhibitor, and in each case it has been shown that the isotope effect increases with decreasing pressure. The relative rate constant expression for the ethyl-h_5, ethyl-d_5 bromide comparison was also obtained in the temperature range 730.9 to 964.8° K, $k_H/k_D = 0.502 \exp(2300 + 200/RT)$. The isotope effect is again pressure dependent, falling to lower values as the pressure is decreased. The data are used to demonstrate that the inhibited decomposition of ethyl bromide is primarily a molecular process, and that the rate-controlling step involves a carbon-hydrogen bond break. A side reaction that produces small amounts of ethane has been observed. (auth)

26880 A STUDY OF CATALYTIC REACTIONS ON SEMICONDUCTORS: HYDROGEN-DEUTERIUM EXCHANGE AND FORMIC ACID DECOMPOSITION ON CHEMICALLY-DOPED GERMANIUM. George Edward Moore (Univ. of Tennessee, Knoxville). Dissertation Abstr., 22: 3008(Mar. 1962).

Rates and activation energies for the hydrogen-deuterium exchange and formic acid vapor decomposition were measured on a series of chemically doped germanium catalysts over the temperature range 100 to 400°C. The germanium catalysts were intrinsic and n- or p-type extrinsic semiconductors; the position of the Fermi level of the solid was located suitably in the forbidden energy gap. Kinetic parameters of the exchange and decomposition reactions were related to the Fermi level (electronic chemical potential) of the solid. Their dependence suggested that the rate-limiting processes involved electronic charge shifts between adsorbate and semiconductor. Two different rate processes appeared to limit the hydrogen-deuterium exchange. A process involving an electron shift from adsorbate to solid appeared to control the rate in the region of n-type semiconductivity. In the region of p-type semiconductivity, the rate-determining process appeared to be an electron shift in the opposite direction (from solid to adsorbate). Dehydrogenation and dehydration of formic acid on germanium were observed. Dehydrogenation was the predominant method of decomposition on p-type germanium; however, dehydrogenation on n-type germanium could not be detected. A process involving an electron shift from adsorbate to solid appeared to control the dehydrogenation reaction. Dehydration of formic acid occurred on all germanium catalysts, and appeared independent of the Fermi level of the solid. Both dehydrogenation and dehydration of formic acid appeared to be primary decomposition processes at the lower temperatures. There was evidence, however, that the water gas equilibrium affected the distribution of products at some of the higher temperatures used. Nonstoichiometry of dehydrogenation products in the gas phase over p-type germanium was detected, and seemed to be explained best by the removal of hydrogen atoms by the germanium during the process of formic acid decomposition.

26881 CARBON-14 LABELED ORGANIC COMPOUNDS. M. Bubner and H. L. Schmidt (Zentralinstitut fur Kernphysik, Rosendorf, Ger.). Isotopentechnik, 2: 143-50 (May 1962). (In German)

Radiochemically pure and well defined labeled compounds are the basis for carrying out many investigations in science and technology. The syntheses of methanol-C^{14}, methyl-C^{14} iodide, C^{14}-nitromethane, C^{14}-pantolax, and C^{14}-carnitin are described as examples of the methods for the preparation of C^{14}-labeled organic compounds. (tr-auth)

26882 MERCURY PHOTOSENSITIZED INTERACTION OF ETHYLENE AND 2,2-DIDEUTERIOPROPANE. John P. Chesick (Yale Univ., New Haven). J. Am. Chem. Soc., 84: 2448(June 20, 1962).

Ethylene–propane mixtures were saturated with mercury vapor at 0°C and circulated through a photolysis vessel at 30°C. Product analyses for runs with unlabeled propane agreed with previous work; the isopentane/n-pentane ratio

was typically 5.0. Runs with 2,2-dideuteriopropane gave different results, with the isopentane/n-pentane ratio dropping to 0.54. Analysis of the isopentane showed less than 0.75% $C_5H_{10}D_2$. It is concluded that excited ethylene does not undergo one-step insertion reactions to any appreciable extent. (D.L.C.)

26883 SYNTHESIS OF ALDOSTERONE-1α,2α-H^3. K. R. Laumas and Marcel Gut (Worcester Foundation for Experimental Biology, Shrewsbury, Mass.). J. Org. Chem., 27: 314(1962).

The method of Osinki et al., was used to synthesize aldosterone-1α,2α-H^3 for use as an indicator in analysis of peripheral blood. 1-Dehydroaldosterone 21-acetate in dioxane was reduced with tritium over 5% palladium-on-charcoal. Aldosterone acetate-1α,2α-H^3 was separated from the products by chromatography and hydrolyzed with lipase or bicarbonate to give aldosterone-1α,2α-H^3. (D.L.C.)

26884 THE CALCULATION OF FORCE CONSTANTS AND NORMAL CO-ORDINATES. II. METHYL FLUORIDE. Joan Aldous and I. M. Mills (Univ. of Reading, Eng.). Spectrochim. Acta, 18: 1073-91(Aug. 1962).

The mathematical difficulties which can arise in the force constant refinement procedure for calculating force constants and normal co-ordinates are described and discussed. The method has been applied to the methyl fluoride molecule, using an electronic computer. The best values of the twelve force constants in the most general harmonic potential field were obtained to fit twenty-two independently observed experimental data, these being the six vibration frequencies, three Coriolis zeta constants and two centrifugal stretching constants D_J and D_{JK}, for both CH_3F and CD_3F. The calculations have been repeated both with and without anharmonicity corrections to the vibration frequencies. All the experimental data were weighted according to the reliability of the observations, and the corresponding standard errors and correlation coefficients of the force constants have been deduced. The final force constants are discussed briefly, and compared with previous treatments, particularly with a recent Urey-Bradley treatment for this molecule. (auth)

26885 ADVANCES IN INORGANIC CHEMISTRY AND RADIOCHEMISTRY. VOLUME 4. H. J. Emeléus and A. G. Sharpe, eds. New York, Academic Press Inc., 1962. 350p.

Six papers on advances in inorganic chemistry and radiochemistry are presented. Topics covered include: condensed phosphates and arsenates; olefin, acetylene, and π-allylic complexes of transition metals; recent advances in the stereochemistry of nickel, palladium, and platinum; the chemistry of polonium; the uses of nuclear magnetic resonance in inorganic chemistry; and oxide melts. Separate abstracts were prepared for 3 of the papers. (M.C.G.)

26886 THE CHEMISTRY OF POLONIUM. K. W. Bagnall (United Kingdom Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.197-229 of "Advances in Inorganic Chemistry and Radiochemistry. Vol. 4." New York, Academic Press Inc., 1962.

Studies of polonium are reviewed. Topics covered include: isotopes, separation of polonium, handling problems and preparative techniques, polonium metal, polonium oxides and sulfides, polonium halides, polonium salts of oxy-acids, other polonium compounds, and the uses of polonium. One hundred and thirty-seven references are included. (M.C.G.)

26887 THE USE OF NUCLEAR MAGNETIC RESONANCE IN INORGANIC CHEMISTRY. E. L. Muetterties and W. D. Phillips (E. I. DuPont de Nemours, Wilmington, Del.). p.231-92 of "Advances in Inorganic Chemistry and Radiochemistry. Vol. 4." New York, Academic Press Inc., 1962.

The physical basis of nuclear magnetic resonance is discussed. Two observables of nuclear magnetic resonance spectroscopy of primary interest in the elucidation of the electronic and geometrical structures of molecules are the chemical shifts of nuclei and nuclear spin-spin coupling constants. Examples illustrating the power of nuclear magnetic resonance in molecular structure determination are given for fluorine compounds, hydrates, metal hydrides, organometallic compounds, and boron compounds. The use of nuclear magnetic resonance in studies of exchange reactions is discussed. Hyperfine contact interaction shifts are described. Application of nuclear magnetic resonance to studies of inorganic solids is also discussed. One hundred and thirty-nine references are included. (M.C.G.)

26888 OXIDE MELTS. J. D. Mackenzie (General Electric Research Lab., Schenectady, N. Y.). p.293-318 of "Advances in Inorganic Chemistry and Radiochemistry. Vol. 4." New York, Academic Press Inc., 1962.

Correlation of the physical properties and structures of oxide melts was studied. It was concluded that pure oxide melts can be divided into three types: network liquids, ionically or electronically conducting melts, and molecular liquids. Binary melts containing SiO_2 and a metal oxide are ionically conducting. It was postulated that the melt is probably composed of small cations and large silicon-oxygen anions the "building" unit of which is the SiO_4 tetrahedron. Sixty-five references are included. (M.C.G.)

26889 THORIUM PHOSPHATE MATRIX LUMINESCENT MATERIALS. Peter Whitten Ranby and Doreen Yvonne Hobbs (to Thorn Electrical Industries Ltd.). U. S. Patent 3,049,497. Aug. 14, 1962.

An artificial luminescent material may be prepared which consists of a thorium phosphate matrix activated by at least one activator of the group Cu (0.005 to 25%), Ce (0.1 to 20%), Sb (0.1 to 20%), and Pb (4 to 16%). When the material contains Cu, it may also contain 0.005 to 15% Ag, 0.05 to 20% Tl, and up to 5% Li, and it may also contain up to 10% Mn. The material may be prepared by heating the mixture to a temperature above 800°C. (D.L.C.)

Analytical Procedures

Refer also to abstract 28560.

26890 (AERE-R-3818) THE MEASUREMENT AND INTERPRETATION OF DIFFRACTION LINE PROFILES. Papers Presented at the Fifth Colloquium of the U.K.A.E.A. Diffraction Analysis Conference held at Bournemouth, March 9th and 10th 1961. M. H. Rand, ed. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Apr. 1962. 80p.

Nine papers are included; separate abstracts have been prepared for each. (N.W.R.)

26891 (AERE-R-3818(p.1-4)) PHYSICAL FACTORS AFFECTING LINE PROFILE. R. W. M. D'Eye (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Physical factors which can be altered to correct the line profile from diffraction equipment are discussed. These factors include: size of the focal spot and the intensity distribution across it, sample arrangement (whether curved or flat), vertical divergence of the beam, width of the receiving slits, scanning speed, speed of the film, film

processing, setting of the slit system, correct voltage range, response to x-ray quanta, length of time to record counts, and stability of the x-ray generator and receiving circuits. Quasi-physical factors discussed include overlapping reflections and absorption of x rays by the specimen. (N.W.R.)

26892 (AERE-R-3818(p.5-18)) THE INTERPRETATION OF TOTAL INTENSITY MEASUREMENTS IN X-RAY AND NEUTRON DIFFRACTION. B. T. M. Willis (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The absorption, temperature, and extinction factors which affect the magnitude of the observed total intensity (integrated reflexion) measurements in x-ray and neutron diffraction are discussed. Information about these factors is gained by accurately measuring the total intensity of the different hkl planes. This information includes the rms amplitudes of vibration of the different atoms in the crystal, the average size of the coherent mosaic blocks, and the average mosaic spread. (N.W.R.)

26893 (AERE-R-3818(p.19-21)) THE STUDY OF LINE-PROFILES IN X-RAY DIFFRACTION PATTERNS OF GRAPHITE. G. E. Bacon (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The study of the width and shape of x-ray diffraction spectra provides considerable information about the crystal structure and texture of graphite, in particular with regards to the graphitization process and the effects of irradiation in reactors. For instance, the misorientation of the layers provides a useful index of the crystallographic perfection and degree of graphitization of any individual sample. It is determined from a detailed comparison of the line-shape for reflections with calculated shapes given by a formula due to Hendricks and Teller. When graphite is subjected to neutron irradiation, carbon atoms are removed from their sites in the structure and many of them remain in interstitial positions between the layers. The initial effect of this on the diffraction pattern is that the mean interlayer spacing is increased and the 0001 lines are gradually shifted to smaller angle values as the irradiation dose increases. (N.W.R.)

26894 (AERE-R-3818(p.22-37)) A.W.R.E. APPARATUS FOR WORK IN PREFERRED ORIENTATION IN URANIUM. M. J. C. Hill (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England).

The Schulz method and apparatus for the examination by reflexion of metal specimens for preferred orientation are used in studying uranium. The design and performance of the apparatus for the x-ray-diffraction analysis of uranium are presented. (N.W.R.)

26895 (AERE-R-3818(p.38-44)) ROUTINE MEASUREMENTS OF CRYSTALLITE SIZE AND STRAIN IN URANIUM DIOXIDE FROM X-RAY LINE BREADTHS. I. F. Ferguson (Springfields).

The salient features in the determination of crystal size and shape and lattice strain by x-ray photographic and diffractometric methods are outlined. The measurements depend upon the application of Scherrer's equation to several broadened x-ray reflexions followed by a Hall plot. The methods are applicable for particles in the 0.1 to 1 micron range. The variations in the results are discussed and presented. (N.W.R.)

26896 (AERE-R-3818(p.45-53)) INTERATOMIC DISTANCES IN α-URANIUM AT 20° AND 630°C. A. L. Sutton, A. M. Price (Culcheth) and W. T. Eeles (Gt. Brit. Central Electricity Generating Board. Berkeley Nuclear Labs., Briston, England).

The lattice parameters of high-purity alpha-uranium were measured by x-ray powder photography at 20 and 630°C. The resulting values of the cell dimensions (a, b, and c) agree to within 1 part in 1000 with previous determinations, and the positional parameter (y) increases from 0.102 at 20°C to 0.110 at 630°C. For the same temperature change, the first and second closest interatomic distances expand by 2.92 and 2.23% respectively, while the third and fourth closest distances change by −0.18 and 0.06 respectively. These changes are consistent with the observed change in the slip system from (010)[100] at room temperature to (001)[100] at 600°C. The estimated diameter of the tetrahedral interstice is appreciably smaller than those of the octahedral and pyramidal interstices at each temperature. The tetrahedral insterstice contracts on heating, while the other two types expand. (auth)

26897 (AERE-R-3818(p.54-60)) THE EVALUATION OF A PURE DIFFRACTION PROFILE FROM EXPERIMENTAL DATA. D. E. Connolly (Springfields).

The problem of deriving an expression for the pure diffraction profile from the experimentally obtainable profiles representing the instrumental weight function and the profile containing diffraction and instrumental functions is discussed with regards to methods already published. The general methods of the Fourier transform and Stokes and Patterson relaxation methods are considered along with non-general methods of Scherrer, Warren and Biscoe, Jones, and Alexander and Klug. If no assumptions as to the shapes of the profiles are to be made, the pure diffraction profile must be computed by either of the two general procedures. If it is fairly certain that the weight and pure diffraction profile functions take particular forms, the non-general methods may be adopted. (N.W.R.)

26898 (AERE-R-3818(p.61-8)) A MERCURY COMPUTER PROGRAMME FOR THE CORRECTION OF X-RAY DIFFRACTION LINE SHAPES. J. W. Harrison (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

A method for the numerical Fourier analysis of a diffraction profile adapted for solution by the Ferranti Mercury computer is described. The stages of the calculation are depicted schematically. The Fourier transform and relaxation methods of Stokes are employed in this method. (N.W.R.)

26899 (AERE-R-3818(p.69-78)) TEMPERATURE ERRORS IN HIGH TEMPERATURE X-RAY POWDER DIFFRACTION CAMERAS. A. Moore and D. A. Cheer (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England).

Experimental methods are described for determining the relevant thermal characteristics of conventional camera designs in which the specimen temperature is measured by a thermocouple adjacent to the specimen. The direct method of assessment of specimen temperature is used from 20 to 300°C. The thermocouple is embedded in a powder specimen of conventional dimensions. This method is limited by any reaction between the thermocouple and the specimen and by the limits of vacuum (10^{-3} mm) attainable in the modified system. The indirect method dispenses with the auxiliary thermocouple embedded in the powder specimen and the measuring thermocouple is calibrated against the thermal expansion characteristics of a suitable standard as deduced from x-ray diffraction data and standard

dilatometric data. The method is applicable from 20 to 960°C. (N.W.R.)

26900 (ORO-485) MOISTURE DETERMINATION IN CORN BY NEUTRON MODERATION. Final Report. Lewis F. Ballard and Ralph L. Ely, Jr. (Research Triangle Inst., Durham, N. C. Isotope Development Lab.). July 31, 1961. Contract AT(40-1)-2513. 15p.

The neutron moderation technique was successfully applied to the measurement of the moisture content of inorganic media such as soil and molding sand. Since the method essentially measures the hydrogen content per unit volume, it becomes more difficult to apply in organic media. In corn, moisture contents from 10 to 20 per cent by weight are equivalent to hydrogen contents of 47.7 to 50.7 per cent. That is, a 10 per cent moisture range is compressed to a 3 per cent hydrogen range. Nevertheless, it is shown that by packing the corn to the same density each time by putting a known weight into a known volume, the moisture content can be measured to a precision determined by the counting statistics. It is concluded that a 100 mc. RaD–Be neutron source or equivalent can measure the moisture content of corn to a precision of 0.5 per cent at the 67 per cent confidence level in 3 minutes. (auth)

26901 (NYO-10058) THE DEVELOPMENT AND USE OF NEW SPECTROSCOPIC METHODS FOR ISOTOPE ANALYSIS AND ZEEMAN EFFECT STUDIES. Final Summary Report, April 1, 1957–March 31, 1962. George R. Harrison (Massachusetts Inst. of Tech., Cambridge). Mar. 31, 1962. Contract AT(30-1)-2013. 22p.

Development of new techniques and equipment for high resolution spectroscopy is discussed. The group of equipment represents the most powerful system yet developed for the application of grating and echelle spectroscopy to complex spectra. It was applied to studies of the Zeeman effect in rare earth spectra, and hyperfine and structure work in rare earths and rare earth analogs. (J.R.D.)

26902 (AEC-tr-5262) USE OF DISCHARGE IN A HOLLOW CATHODE FOR DETERMINING IMPURITIES IN ZrO_2. Yu. I. Korovin and L. V. Lipis. Translated for Oak Ridge National Lab., Tenn. from Optika i Spektroskopiya, 5: 334-37(1958). 8p.

It was demonstrated that discharge in a hollow cathode can be used successfully for analyzing ZrO_2 for foreign elements. Helium was used as the carrier gas. The sensitivity of determination is a logarithmic function of the size of the batch, and the optimal weight of the sample was 30 to 50 mg. For all current intensities examined, ranging from 200 to 1400 ma, only few very intense Zr lines were present in the discharge spectrum in addition to the lines for the impurities. The sensitivity of determination and the analytical lines (pairs) of the elements are given. Designs of the hollow cathode apparatus and discharge tube are also included. (P.C.H.)

26903 (AEC-tr-5270) ANALYSIS OF MIXTURES OF H_2O AND D_2O BY INFRARED DETERMINATION OF MOLECULAR EXTINCTION COEFFICIENTS. M. Ceccaldi. Translated by J. L. Crandall and L. M. Petrie (Savannah River Plant, Aiken, S. C.) from Rev. universelle mines (9) 15: (1959). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 5025.

26904 (AEC-tr-5276) THE DETERMINATION OF OXYGEN IN ZIRCONIUM AND ZIRCALLOY BY SPECTROGRAPHIC EMISSION IN AN ARGON ATMOSPHERE. J. Artaud and C. Berthelot. Translated from Mém. sci. rev. mét., 57: 338-44(May 1960). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 20158.

26905 (CEA-tr-A-1127) DÉTERMINATION DE LA TENEUR EN EAU D'ARBRES VIVANTS À L'AIDE DE NEUTRONS RAPIDES ET DE RAYONNEMENTS GAMMA DE BASSE ÉNERGIE. (Determination of the Water Content of Living Trees Using Fast Neutrons and Gamma Rays at High Energies). W. Kuehn. Translated into French from Kerntechnik, 3: 382-5(1961). 24p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 27573.

26906 (CEA-tr-X-438) SEPARATION ET DOSAGE DE L'URANIUM(VI) EN PRESENCE D'URANIUM(IV) ET D'AUTRES CATIONS. (Separation and Determination of Uranium(VI) in Presence of Uranium(IV) and Other Cations). Jorge Alberto Blay (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). Translated into French from Report No. 48. 1960. 28p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 22249.

26907 (CEA-tr-X-446) DETERMINATION PHOTOMÉTRIQUE DE TRACES DE FER DANS L'URANIUM MÉTAL. (Photometric Determination of Traces of Iron in Uranium Metal). Daido Ishii. Translated into French from Bunseki Kagaku, 9: 693-7(Aug. 1960). 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 10876.

26908 (UCRL-Trans-851) ON ELECTROPHORETIC ION FOCUSSING. X. THE ANALYSIS OF RARE EARTH MIXTURES. Walter Friedli and Ernst Schumacher. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Berkeley) from Helv. Chim. Acta, 44: 1829-56(1961). 45p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 9960.

26909 A RAPID METHOD OF MEASURING PLUTONIUM IN RADIOACTIVE EFFLUENTS. J. Scheidauer and L. Messainguiral (Commissariat a l'Energie Atomique, Paris). Anal. Chem., No. 10, 462-4(Oct. 1961). (CEA 2090). (In French)

Plutonium is first separated by a lanthanum fluoride precipitation and the precipitated fluorides are dissolved in normal nitric acid solution in the presence of aluminum nitrate. The plutonium transformed to the tetravalent state is then extracted with thenoyltrifluoacetone and returned to the aqueous phase with 10 N nitric acid. After evaporation on a watch glass the residue is calcined on a Meker burner and counted using a counting system fitted with a zinc sulfide scintillator. When necessary, the calcium is eliminated at the beginning of the dosage by a fluoride precipitation, the plutonium being oxidized to the (IV) state. (auth)

26910 ACTIVATION ANALYSIS FOR OXYGEN AND OTHER ELEMENTS BY HELIUM-3-INDUCED NUCLEAR REACTIONS. Samuel S. Markowitz and John D. Mahony (Univ. of California, Berkeley). Anal. Chem., 34: 329-35 (Mar. 1962). (UCRL-9908)

A rapid activation analysis was performed for oxygen in beryllium, thorium, and Mylar samples. The ultimate sensitivity is in fractions of a part per billion. Milligram amounts of total sample are sufficient. The method can be used to analyze for other elements and for specific nuclides. More than one element can be determined in the same activation. The sample need not be destroyed. Because of the low binding energy of the He^3 incident projectile, many He^3 nuclear reactions are exoergic, permitting radioactive products to be formed with large cross section

from a beam of low kinetic energy. The absolute excitation function was determined for the production of F^{18} from O^{16} reaction with He^3 ions of kinetic energy up to 31 Mev. The induced radioactivity was measured by calibrated end-window proportional counters and NaI scintillation spectroscopy. Brief bombardment of a 0.001-inch thorium foil with 0.01 μa of He^3 gave sufficient F^{18} radioactivity from O^{16} impurity to distinguish easily the 0.51-Mev annihilation radiation from the nuclear γ rays emitted by thorium and its daughters. Methods for eliminating or minimizing interferences are discussed. Nuclear reactions of low-energy He^3 ions with nuclides up to Ca^{48}, product half lives, and reaction Q values are listed. (auth)

26911 A STUDY OF THE DETERMINATION OF OXYGEN IN BERYLLIUM BY VACUUM FUSION. M. R. Everett and G. E. Thompson (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.). Analyst, 87: 515-29(July 1962).

The relatively high vapor pressure of beryllium metal at the temperature required for the vacuum fusion reduction of its oxide by carbon can lead to severe gettering and loss of part of the carbon monoxide evolved in the reaction. Low and variable results for oxygen will be obtained unless the design of the vacuum fusion apparatus and operating technique are carefully controlled. These design and operating factors were investigated in part by fitting a recording ionization gage to the furnace head of a micro platinum-bath vacuum fusion apparatus, thus monitoring the progress of vacuum fusion reactions and the rate of removal of gas from the furnace head. The gage was used under static and dynamic gas conditions to investigate the gettering action of beryllium evaporated during the vacuum fusion of a sample. Other factors investigated include: the pumping speed characteristic of the gas-transfer diffusion pump, the vacuum fusion temperature, the enclosure of samples in capsules, the use of a tin addition with the sample, sample size, and the method of sampling. The most important factors are the maintenance of high pumping speeds for high pressures at the crucible and the use of capsules to enclose all samples. (auth)

26912 THE IDENTIFICATION AND DETERMINATION OF FOREIGN PHASES AND CONSTITUENTS IN METALS, WITH SPECIAL REFERENCE TO BERYLLIUM. H. P. Rooksby and I. R. Green (General Electric Co. Ltd., Wembley, Eng.). Analyst, 87: 539-45(July 1962).

The wide scope of analysis required to permit a correlation to be established between the constitution and properties of a metal is discussed. The view is expressed that the state of combination and the manner of distribution of impurities, as well as the amounts present, must be determined. This is shown by reference to analytical work on beryllium; results on several different commercial varieties are reported. Attention is directed to the presence of several impurity phases, including oxide, carbide, nitride, and elemental silicon and aluminium. Two intermetallic compounds were denoted, but are incompletely identified. The value of selective solution methods for isolating some non-metallic constituents is stressed. (auth)

26913 DETERMINATION OF STRONTIUM IN BIOLOGICAL MATERIALS AND EXCHANGEABLE STRONTIUM IN SOILS BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. D. J. David (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia). Analyst, 87: 576-85(July 1962).

An examination was made of factors affecting the determination of strontium in biological materials and soil extracts by atomic-absorption methods. Calcium and phosphate together in solution seriously depress absorption of the 4607 Å strontium resonance line, but neither calcium not phosphate alone produces serious depression. In all sample solutions tested, except those from some acid soils, adequate natural calcium was present to suppress the interference from aluminium. The method recommended for biological materials consists in the removal of phosphate by means of De-Acidite FF anion-exchange resin and then atomic-absorption spectrophotometric analysis by the addition method. Ammonium chloride extracts of soils usually require no pre-treatment to suppress interferences, but it is sometimes necessary to remove the ammonium chloride and concentrate the solutions to improve accuracy. Results are given of experiments to determine the efficiency of anion exchange in separating phosphate from strontium and to assess the accuracy and reliability of the application of the addition method to atomic-absorption analysis. (auth)

26914 THE DETERMINATION OF OXYGEN BY FAST-NEUTRON ACTIVATION. R. F. Coleman (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Analyst, 87: 590-3(July 1962).

A method is described for determining oxygen in most elements by fast-neutron activation. Nitrogen-16 produced in the reaction $O^{16}(n,p)N^{16}$ with 14.5-Mev neutrons is detected by counting high-energy gamma rays. A wide variety of metals was analyzed, and results generally agree with those obtained by vacuum fusion. The limit of detection is about 10 ppm of oxygen. (auth)

26915 THE DETERMINATION OF URANIUM DIOXIDE WITH A HYDROCHLORIC ACID–ETHYL ACETATE SOLVENT. A. W. Ashbrook (Eldorado Mining and Refining Ltd., Ottawa). Analyst, 87: 595-7(July 1962).

A method for separating uranium dioxide from U_3O_8, uranium trioxide, uranium carbide, and uranium metal using a hydrochloric acid-ethyl acetate solvent is described. The solubility of uranium dioxide in this solvent is found to be dependent on the composition of the oxide. As the ratio of uranium to oxygen increases from (1 to 2) to (1 to 2.667), the solubility increases from zero to 100%. (N.W.R.)

26916 RADIOCHEMICAL PURITY CONTROL OF ^{131}I. H. Schroeder (Kernforschungszentrums Karlsruhe, Ger.). Atompraxis, 8: 265-9(July 1962). (In German)

A simple but sensitive method for regular supervision of the radiochemical purity of I^{131} was devised. After the iodine is separated from the solution to be examined, the remaining activity is identified. The procedure can be used for examining all I^{131} samples, regardless of their origin. (auth)

26917 ACTIVATION ANALYSIS USING A RESEARCH REACTOR. J. D. Buchanan (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Atompraxis, 8: 272-6(July 1962). (In English)

Results of activation analysis with the Triga Mark 1-research reactor on the John Jay Hopkins Laboratory are described. By use of a rotary specimen rack it is possible to irradiate 80 specimens simultaneously at the same average neutron flux. Irradiations for activation products with half lives greater than about minutes are normally performed in the rotary specimen rack and the reactor is usually operated at a power level of 250 kW by a thermal neutron flux of 1.8×10^{12} n cm^{-2} sec^{-1}. Irradiations of products with half lives of approximately 10 min or less are usually performed with a pneumatic transfer system in a

fuel-element position in the core. Calibration is carried out by simultaneous irradiation of reference standards of the elements. The postirradiation treatment is analyzing by using gamma spectrometry. If necessary radiochemical separations are performed. The different techniques of treatment and counting are described. The sensitivity of the method is confirmed by results of activation analysis of a most different kind of substance. (auth)

26918 CHEMICAL AND RADIOCHEMICAL ANALYSIS AND PURIFICATION OF THE HEAVY WATER TAKEN FROM THE RA REACTOR. Zoran B. Maksimović, Tatjana Ćeranić, and Momir Marinković. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 13: No. 1, 19-33(Apr. 1962). (In English)

The methods for chemical and radiochemical analysis of the heavy water taken from the RA reactor are presented. The data obtained show that the bulk of the activity comes from Co^{60} and S^{35}. The spectrochemical analysis proved the presence of some other elements. The method is also described which is used for the purification of heavy water by ion exchangers, with the purpose of determining the tritium present in it. The decontamination factor obtained by this method was 10^5. The electrical conductivity of the heavy water was measured before and after purification. (auth)

26919 PHOTOMETRIC DETERMINATION OF CERIUM(IV) EMPLOYING DIPHENYLAMINE. Edith Mayaud (Radio Corp. of America, Lancaster, Penna.). Chemist Analyst, 51: 36-7(July 1962).

A method is outlined for determining cerium(IV). The method involves the formation of a violet color of diphenylamine at an oxidation potential above + 0.76 v (that of cerium(IV) is + 1.44 v) and photometric measurement of the 575 mμ peak. The acid conditions, order of reagent addition, and other variables are important for stable color. The method may also be applied to determination of total cerium by addition of a persulfate oxidation step. (D.L.C.)

26920 PHOTOMETRIC EDTA TITRATION OF THORIUM WITH β-SNADNS-6 AS INDICATOR. Sachindra Kumar Datta and Sachindra Nath Saha (Victoria Coll., Cooch Behar, West Bengal, India). Chemist Analyst, 51: 49-50(July 1962).

A method for determining Th is outlined which can detect as little as 10 μg of Th. The method comprises adding 3-(6-sulfo-2-naphthylazo)-chromotropic acid (β-SNADNS-6) to the buffered acidic Th solution, adding small increments of EDTA in steps, and measuring the absorbance at 590 mμ between steps. (D.L.C.)

26921 MICROCALORIMETRIC QUANTITATIVE ANALYSIS OF A MIXTURE OF PLUTONIUM-239 AND PLUTONIUM-240. Pierre Boivinet, Edouard Calvet, and Yves Ozias (C.N.R.S., Marseille). Compt. rend., 254: 2964-6 (Apr. 16, 1962). (In French)

The E. Calvet microcalorimeter was used to analyze a mixture of Pu^{239} and Pu^{240} in the form of the oxide PuO_2, sealed in cylinders of irradiated platinum. It was verified that the corrective terms caused by traces of Pu^{241} and Am^{241} can be neglected in the case of the samples studied, and a general method for the determination of these corrective terms is given. The principle of the method is explained in some detail, and the experimental results are given. The relative errors are 0.5% for Pu^{239} and 5 to 10% for Pu^{240}. (J.S.R.)

26922 THE POLAROGRAPHY OF TECHNETIUM IN PERCHLORATE SOLUTIONS. A. F. Kuzina, S. I. Zhdanov, and Vikt. I. Spitsyn (Inst. of Physical Chemistry. Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 836-9(June 1, 1962). (In Russian)

The polarographic behavior of NH_4TcO_4 in 1.0 M $NaClO_4$ was investigated over a wide range of acid and alkali concentrations. The concentration of Tc was determined by 4π counting. In neutral 1.0 M $NaClO_4$ solutions, a clear TcO_4^- wave was obtained at a half-wave potential $\Phi_{0.5}$ of about 0.8 volt. The limiting current of this wave was proportional to the concentration of Tc in the interval of 0.5×10^{-5} to 8×10^{-5} molar in Tc. An analysis of the Il'kovich equation showed a valence change of 3.4 for the reduction of TcO_4^- in neutral solution. Two large maxima at $\Phi_{0.5} = -1.4$ and -1.8 were also observed in neutral 1.0 M $NaClO_4$ solutions. The limiting current was not proportional to the concentration of Tc for these half-wave potentials. On acidifying the solution, a new wave was observed at $\Phi_{0.5} = -0.6$ volt. No clear wave could be observed in 4.0 M $HClO_4$. At 6.3×10^{-3} M KOH, the valence change was only 2.4 at $\Phi_{0.5} = -0.87$ volt. At 0.3 N KOH, the wave split into two waves at $\Phi_{0.5} = -1.2$ volts. In alkaline solutions the reduction of TcO_4^- went to the pentavalent state, or at higher potentials, to the hexavalent state. (TTT)

26923 DETERMINATION OF URANIUM, THORIUM, AND LEAD IN ZIRCONS BY X-RAY FLUORESCENCE. Armand Buchs (Universite, Geneva). Helv. Chim. Acta, 45: 741-8(1962). (In French)

A procedure for the determination of U, Th, and Pb in zircons by x-ray fluorescence is described. On 200-mg samples concentrations of the order of 10 to 10,000 ppm can be determined with a precision sufficient for calculating the α activity of zircons. The results are discussed. (tr-auth)

26924 CONTINUOUS pH AND CONDUCTIVITY MEASURING OF DISTILLED WATER IN PRIMARY CYCLE OF CZECHOSLOVAK NUCLEAR REACTOR. F. Voženílek and J. Vojta. Jaderná energie, 8: 156-9(1962). (In Czech)

The development of pH and conductivity measurements of water in primary cycle of an experimental reactor of the Czechoslovak Academy of Sciences is described. The experience gained during operation, and results of measurements, are reported as well. (auth)

26925 ON THE STUDY OF THE INDIRECT APPLICATION OF RADIOACTIVE NUCLEI IN ANALYTICAL CHEMISTRY. PART III. B. C. Purkayastha and M. N. Chandra (Saha Inst. of Nuclear Physics, Calcutta). J. Indian Chem. Soc., 39: 231-4(Apr. 1962). (In English)

Application of co-ordination compounds to extend the use of I^{131}, an easily available isotope of convenient half life, in the determination of mercury and cadmium was made. The principle employed was to add excess of labeled iodine as KI to neutral solution of mercury or cadmium to which was then added a solution of copper ethylenediamine sulfate in slight excess. The precipitate was then allowed to settle and activity of a portion of the solution was measured with a liquid counter. The loss in activity was a measure of mercury or cadmium. Cadmium and mercury from 50 mg. to 0.1 mg. were estimated. The data always lay within statistical fluctuations. It is a quick and reliable method for the estimation of mercury and cadmium even in very small concentrations. (auth)

26926 ESTIMATION OF THE SPECIFIC ACTIVITY OF RADIOACTIVE PRODUCT BY RADIOMETRIC TITRATION. Fujio Kametani, Kan Kimura, and Akira Kataoka. Nippon Genshiryoku Gakkaishi, 4: 373-7(1962). (In Japanese)

Quantitative analysis of tracer elements by radiometric titration is found to have the advantage that the radioactivity is not brought into the tracer element by the addition of radioactive indicator but is originally in the element to be determined. Furthermore, it is possible by titration to

measure the radioactivity of the tracer while determining the weight. Estimation of specific activities of Zn^{65} and U^{237} by titration is presented. Total zinc in Zn^{65} and total uranium in U^{237} tracers are titrated radiometrically with potassium ferrocyanide or sodium hydroxide and disodium phosphate standard solutions, respectively. A micro amount of zinc is titrated by extracting the dithizonate with carbon tetrachloride. In both cases, the counter used is calibrated with a Zn^{65} or U^{237} standard. This radiometric method has the advantage of simplicity, in that no special indicator and no instruments other than a γ-ray counter are necessary for determination of the metal ion concentration. (auth)

26927 DETERMINATION OF THORIUM IN VARIOUS AQUEOUS SAMPLES BY ANION EXCHANGE. II. ANALYTICAL METHOD OF URINE, TAP WATER AND SEA WATER. Jun Akaishi. Nippon Genshiryoku Gakkaishi, 4: 386-9(1962). (In English)

The method proposed is as follows: thorium is coprecipitated with the basic phosphate precipitates of calcium and magnesium in a sample of a large volume; the precipitate is dissolved with 1N nitric acid and the solution is made 40 vol. % 1N nitric acid–60 vol. % ethanol mixed solution by adding ethanol; the resultant solution is passed through a resin column; the column is washed with 20 vol. % 1N nitric acid–80 vol. % ethanol mixed solution, and then with water; elution is carried out with 8N hydrochloric acid; and the amount of thorium is determined by a photoelectric spectrometer, using neo-thorin. The sensitivity is 0.5 to 1.0 μg Th, and recovery for μg amounts of thorium is 99% for 400 to 600 ml of human urine, and 97 or 96% for 1,000 ml of tap water or sea water, respectively. (auth)

26928 ANALYSIS OF Al, Cr, Fe, Mo, Nb, Ni, Ti, V, AND Zr–U ALLOYS. 8-QUINOLINOL, 2-METHYL-8-QUINOLINOL, AND DIMETHYLGLYOXIME EXTRACTION-PHOTOMETRIC METHOD. Hiroshi Hashitani (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 287-93(May 1962). (In Japanese)

The preparation of many uranium base alloys necessitated a rapid and accurate analytical method for the determination of additive elements. The alloys are binary uranium base alloys of Al, Cr, Fe, Mo, Nb, Ni, Ti, V, and Zr, and the additives constituted 0.1 to 5 at.% of the alloys. The extraction-photometric method was used with the following reagents: 8-quinolinol for Al, Fe, Mo, Nb, and V; 2-methyl-8-quinolinol for Cr and Ti; and dimethylglyoxime for Ni. In each case, masking agent for U, optimum pH range for extraction, washing of the extract, and wavelength for absorbance measurement were studied. The reproducibility and accuracy of all the methods were satisfactory, and some of the methods are being used for routine analysis. (auth)

26929 A REVIEW OF THE METHODS USED FOR THE DETERMINATION OF HYDROGEN IN URANIUM. Harold F. Waldron (Mallinckrodt Chemical Works, Saint Charles, Mo.). Nuclear Sci. and Eng., 13: 366-73(Aug. 1962).

Of the many published methods for determining hydrogen in uranium, those based on complete separation of the gas by vacuum or inert-gas extraction are the most satisfactory. When 5- to 10-g samples are used, the average operator time can be reduced to about ten minutes per sample for either of these techniques. Routine operation of one inert-gas and six vacuum extraction units has produced an over-all laboratory precision of ±0.3 ppm for production material containing up to 7 ppm H_2. Improved precision, at a considerable expense of time, can be obtained with larger samples. (auth)

26930 AN IMPROVED PROCEDURE FOR U^{235} ISOTOPIC RATIO ANALYSIS IN IMPURE MATERIALS. W. D. Kelley and B. L. Twitty (National Lead Co. of Ohio, Cincinnati). Nuclear Sci. and Eng., 13: 374-7(Aug. 1962).

An improved neutron activation procedure for determining the U^{235} content in impure uranium samples is presented. With 95% confidence, a relative precision of ±1% is obtained at the level of 0.7 wt. % U^{235}. An ethyl acetate extraction is used to purify the uranium chemically. Most of the uranium decay products are removed by extraction with 2-thenoyltrifluoroacetone (TTA) in xylene. The purified uranium, which is subsequently activated as U_3O_8, has a consistent gamma background level. Utilization of a $1\frac{7}{8}$-in. i.d., well scintillation crystal has permitted the use of large diameter aluminum planchettes holding 2 gm aliquots of U_3O_8. This system has minimized the problem of varying irradiation geometrics caused by differences in U_3O_8 bulk density. Data from a sample recycle program are presented to illustrate the relative precision of ±1%. Comparisons between neutron activation and mass spectrometric results agree within ±1%. (auth)

26931 A NOTE ON ACTIVATION ANALYSIS WITH NEUTRON-INDUCED THRESHOLD REACTIONS. J. J. van Loef (N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands). Nukleonik, 4: 151-2(Apr. 1962). (In English)

In a discussion of the suggestion that some elements, such as titanium and iron, might be determined with an activation analysis carried out with fast neutrons in a reactor, the advantages and disadvantages of such a scheme are reviewed. The radioisotopes of Ti, Fe, and Ni produced by neutron capture and by (n,p) reactions, and their half life and gamma energies are tabulated. In a comparison of the two types of analysis, a figure of merit—the product of natural abundance, cross section, and number of gamma transitions per nuclear disintegration—was introduced and tabulated for the three isotopes. These results indicate that neutron-induced threshold reactions may be appropriate in some cases for trace analysis. (J.S.R.)

26932 SPECTROCHEMICAL DETERMINATION OF Sm, Eu, Gd, AND Dy IN REACTOR GRAPHITE. E. Golling and R. Zagel (Siemens-Schuckertwerke A. G., Erlangen, Ger.). Nukleonik, 4: 153-8(June 1962). (In German)

A spectrochemical method for the detection of Sm, Eu, Gd, and Dy in the concentration range from 10^{-6} to 10^{-1}% was worked out. The graphite samples were ashed at 800°C and the rare earths in the ashes were enriched with Tm as trace carrier and internal standard. The excitation of the spectra took place in a "buffered" carbon arc of 15 amp. In reference to 100 g graphite samples, the following limits of detection were obtained: Sm, 8.5×10^{-6}%; Eu, 4.0×10^{-6}%; Gd, 8.5×10^{-6}%; and Dy, 7.0×10^{-6}%. The relative accuracy is ±20%. The agreement of the microscopic effective cross section of graphite calculated from the analytical values with the neutron absorption measurements in a pile oscillator is satisfactory. (tr-auth)

26933 CHROMATOGRAPHIC SEPARATION OF MICROQUANTITIES OF Np AND Pu ON KU-1 AND KU-2 CATION RESINS. V. D. Zagrai and L. I. Sel'chenkov. Radiokhimiya, 4: 181-4(1962). (In Russian)

Separation of 98 ± 2% of Np and Pu was achieved using KU-1 and KU-2 cation resins (with $>10^3$ separation coefficient) with 0.02 n hydrofluoric acid eluant. The optimum conditions were found for quantitative sorption of Np on KU-1 and KU-2, and coefficients of Np and Pu distribution on KU-1 were determined as function of hydrofluoric acid concentration. (R.V.J.)

26934 ORGANIC CO-PRECIPITATORS. XVI. CONCENTRATION AND PHOTOMETRIC DETERMINATION OF

Th IN NATURAL WATERS. V. I. Kuznetsov, T. G. Akimova, and O. P. Eliseeva. Radiokhimiya, 4: 188-93 (1962). (In Russian)

Co-precipitation of Th with methyl violet taunate from sea and river waters using $UX_1(Th^{234})$ was studied. It was found that coprecipitation of thorium is possible in water with pH = 4 to 9. Photometric determination of thorium in precipitate was achieved using arsenazo III following the decomposition of organic substance by wet burning and separation of thorium by precipitation. The method is sensitive to 0.5 γ of thorium. (R.V.J.)

26935 ZIRCONIUM BASE IONITE. II. APPLICATIONS OF ZIRCONYL OXALATE FOR DETERMINING Sr^{90} BY ITS DAUGHTER PRODUCT Y^{90} IN SEA WATER. Yu. D. Sinochkin, D. A. Perumov, S. A. Patin, and E. G. Azhazha. Radiokhimiya, 4: 198-205(1962). (In Russian)

The application of zirconyl oxalate as a sorbent for separating $Sr^{90}-Y^{90}$ in the presence of large quantities of calcium was analyzed. The results were used for developing a simple method for analyzing sea water for Sr^{90}. The results of measurements of Sr^{90} in the Atlantic ocean and Black sea are tabulated. (R.V.J.)

26936 CHROMATOGRAPHIC SEPARATION OF Np FROM U, Pu AND FISSION PRODUCTS. Yu. A. Zolotov and D. Nishanov. Radiokhimiya, 4: 241-4(1962). (In Russian)

A method of separating Np, Pu, and U by cation exchange is described. Neptunium(V) is eluted from the cation column by 1M nitric acid ahead of U(VI) and other fission products. Then it is purified by ether extraction of oxidized hexavalent neptunium. Cation resin KU-2 and 1M nitric acid reduce hexavalent Np to pentavalent. (R.V.J.)

26937 ULTRAVIOLET SPECTROPHOTOMETRIC DETERMINATION OF SCANDIUM WITH TIRON. Hiroshi Hamaguchi, Naoki Onuma, Rokuro Kuroda, and Ryuitiro Sugisita (Tokyo Univ.). Talanta, 9: 563-71(July 1962). (In English)

A method is described for the spectrophotometric determination of 3 to 250 μg of scandium with tiron. The molar extinction coefficient of scandium in an acetate buffer (pH 6.0) is 8×10^3 at 310 mμ. Small amounts of aluminum, titanium, iron, cerium, molybdenum, thorium, and zirconium seriously interfere. Organic anions such as oxalate, citrate, tartrate, and malate form complexes with scandium. Both 1:1 and 1:3 complexes of scandium with tiron are suggested. (auth)

26938 ISOTOPIC-DILUTION ANALYSIS BY SOLVENT EXTRACTION. IV. SELECTIVE DETERMINATION OF TRACES OF COPPER WITH DITHIZONE. Jaromír Růžička and Jiří Starý (Faculty of Technical and Nuclear Physics, Prague). Talanta, 9: 617-19(July 1962). (In English)

Copper was determined by a single extraction in the form of a complex with dithizone in amounts of 10^{-7} to 10^{-10} g/ml. Even a large excess of metals which form extractable complexes with dithizone do not interfere in the analysis. The method is simple and rapid, consisting of a single extraction of the solution to be analyzed, and measurement of the activity of the extract. The procedure is more sensitive than other methods of determining copper. (auth)

26939 NEUTRON ACTIVATION ANALYSIS AND ITS MEASUREMENT TECHNIQUES. F. Baumgaertner (Technische Hochschule, Munich). Telefunken Ztg., 35: No. 135, 4p. (1962). (In German)

The technique and possibilities of activation analysis and the experience gathered in this connection using Telefunken nuclear radiation measuring equipment are described. The activation analysis is a valuable addition to the other methods of analysis since it is free of errors caused by subsequent tracelike contaminations. The activation analysis is suitable both for the quantitative determination and the qualitative analysis of unknown elements. Three methods are described in detail of testing the purity of the activity: testing of constant specific activity, recording the drop in activity as a function of time, and the spectroscopic examination of gamma rays. The gamma spectrum Sb^{122} is shown, recorded by a Telefunken pulse height analyzer. The gamma spectrum of a sample of streptomycin is shown, the sample being outside the NaJ(Tl) crystal, whereas a similar spectrum is shown of a sample inside the hole crystal. (auth)

26940 COMPLEXOMETRIC DETERMINATION OF RARE EARTHS IN PRESENCE OF Al, Fe, Ca, Th, AND F. A. F. Kuteinikov and V. M. Brodskaya (All-Union Scientific Research Inst. of Mineral Resources, USSR). Zavodskaya Lab., 28: 792-4(1962). (In Russian)

Trilonometric titration of rare earths with arsenazo I in the presence of Al, Fe, Ca, and Th at pH = 5 (in case of Th with initial pH = 2) masking the sulfosalicylic acid complexing is described. (R.V.J.)

26941 COMPLEXOMETRIC DETERMINATION OF Hf IN MIXTURE WITH ZIRCONIUM. L. I. Kononenko and N. S. Poluektov (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Zavodskaya Lab., 28: 794-6(1962). (In Russian)

Complexometric determination of Hf in prepared mixtures of Hf and Zr oxides is based on direct titration by complexon in presence of a new indicator (4-sulfo-2 oxynaphthalene-1 azo-4'-1', 3'-dioxybenzene). Tons of SO_4^{2-} up to 250 mg and Sn(II) and Sn(IV) up to 100 mg do not interfere with the titration. The determination takes from 1.5 to 2 hours. (R.V.J.)

26942 IODATE-COMPLEXOMETRIC DETERMINATION OF THORIUM. A. I. Busev, V. M. Ivanov, and V. G. Tiptsova (Moscow State Univ.). Zavodskaya Lab., 28: 799-800(1962). (In Russian)

An iodate-complexing method was developed for thorium determination followed by titration with a standard copper sulfate solution. The procedure takes 15 min. The tabulated results show that only Ti and Zr interfere with the process by precipitating with the iodate in acid medium. (R.V.J.)

26943 SPECTROPHOTOMETRIC DETERMINATION OF V IN ALLOYS. Zavodskaya Lab., 28: 802-4(1962). (In Russian)

Determination of 0.05 to 0.2% V in Fe, Co, Cr, and Ni alloys in the form of vanadate is described. Following dissolution in mineral acids the alloy is precipitated by cupferron and fused with $KNaCO_3$ at 850 to 900°C. (tr-auth)

26944 DIRECT COMPLEXOMETRIC DETERMINATION OF Zr IN COPPER–ZIRCONIUM ALLOYS. V. F. Luk'yanov and E. M. Knyazeva. Zavodskaya Lab., 28: 804-5 (1962). (In Russian)

A direct complexometric determination of Zr by trilon-B in 0.5 n sulfuric acid with xylenol-orange indicator is described. The presence of Cu is masked by thiourea. (R.V.J.)

26945 FAST DETERMINATION OF B, Li, Ca, AND OTHER ELEMENTS ON A "NEUTRON" TYPE INSTALLATION. A. L. Yakubovich and E. I. Zaitsev (All-Union Inst. of Mineral Resources, USSR). Zavodskaya Lab., 28: 819-23(1962). (In Russian)

Equipment, procedures, and results are given for neu-

tron absorption determination of elements with large neutron capture scattering cross sections. (R.V.J.)

26946 SPECTROGRAPHIC ANALYSIS APPARATUS AND PROCESS. Maurice Stephen William Webb, Robert John Webb, and Peter Charles Wildy (to United Kingdom Atomic Energy Authority). British Patent 900,423. July 4, 1962.

An apparatus and a process for direct spectrographic measurement of small amounts of a selected element in a gas are described which give results unaffected by the particle size of the element or compound being measured. The apparatus and process are described with particular reference to beryllium in air. In the process, filtered air is fed into an intermittent electric arc discharge, the gas is withdrawn from the discharge, the radiation emitted by the discharge is split into a spectrum, and the intensity of a line characteristic of beryllium is measured relative to the background. (D.L.C.)

26947 QUALITATIVE ANALYSIS OF LOOSE SOLIDS BY IRRADIATION AND APPARATUS THEREFOR. (to Stamicarbon N. V.). British Patent 902,478. Aug. 1, 1962.

An apparatus was developed for use in preparing loose solid material for illumination or irradiation by a measuring instrument which yields an indication of the quality of the material. It was previously proposed to grind the material in order to obtain a smooth surface. The apparatus consists of two rollers, one at least of which is a driven roller, which are mounted in juxtaposition so that finely divided material can be fed between the peripheral surfaces of the rollers and be compacted thereby. A means, i.e., a groove, is provided for retaining the compacted material against the surface of one of the rollers as it emerges from between the rollers. Subsequently, the resulting body of material is passed under the source of the radiation or the light source. One of the applications of this method of analysis is in the processing of ores and raw coal. (M.C.G.)

26948 IMPROVEMENTS IN OR RELATING TO ABSORPTIOMETERS. Colin David Reid, Alec Donald Street, Daniel Fraser Davidson, and Stanly Alexander Dean (to United Kingdom Atomic Energy Authority). British Patent 902,732. Aug. 9, 1962.

An absorptiometer is designed which is applicable to the infrared analysis of gases, e.g., CO_2 or HF. Besides the light source, absorption tube, and a detector in the light path, the absorptiometer has means in the light path for allowing different light wavelengths to impinge sequentially and repetitively on the detector to give an absorption signal at one frequency and a standardizing signal at a second frequency. (D.L.C.)

26949 PROCESS MONITORING ANALYZER. Robert G. Bearden, Robert B. Kimball, Harry Schneider, and Leander G. Schwieger (to Phillips Petroleum Co.). U. S. Patent 3,045,122. July 17, 1962.

An optical analyzer system is designed for analyzing fluid samples, particularly sample streams containing uranyl nitrate. The system is provided with warning means in case of malfunction within the analyzer or detector, and with an analysis cycle and a reference cycle. The operation of the system is described in detail. (D.L.C.)

26950 METHOD AND APPARATUS FOR DETECTION OF GASES AND VAPORS. James E. Lovelock (to National Research Development Corp.). U. S. Patent 3,046,396. July 24, 1962.

A method is given for determining the concentration of gases, especially organic gases, in the rare gas stream issuing from a chromatographic column by means of ionization. Ionizing radiation is applied to the rare gas to produce long-lived metastable excited atoms which thereupon ionizes the organic gas. The ionized organic gas may be measured in an ionization chamber or by means of a discontinuous spark discharge. Detectors for carrying out the method are described. (D.L.C.)

26951 PROCESS FOR CONDUCTING QUANTITATIVE ANALYSES. Rhoderick K. Saunders and Rollie B. Williams (to Esso Research and Engineering Co.). U. S. Patent 3,048,772. Aug. 7, 1962.

A process is given for using nuclear magnetic resonance to derive a signal which is a quantitative measure of a nuclear species. The process is based on the detection of a maximum in the dispersion signal obtained by precessing the polarized nuclei with an alternating r-f magnetic field and scanning the resonance band while modulating the primary magnetic field. The use of a nuclear magnetic resonance spectrometer to control a chemical process and a distillation process is discussed in some detail. (D.L.C.)

General Inorganic and Physical Chemistry

26952 (AERE-R-4027) THE DETERMINATION OF TANGENTIAL VELOCITIES IN HYDRAULIC CYCLONES. D. Bradley (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Apr. 1962. 55p.

The distribution of the tangential velocity in hydraulic cyclones was measured by different experimental techniques and with different designs of cyclone. Comparisons were made with previously reported measurements to give information on the reliability of the different techniques and to add to the information on flow in cyclones. (auth)

26953 (ARL-62-336) RESEARCH ON SPECTRALLY SELECTIVE MATERIALS AND SURFACES. Horace R. Moore and Richard E. Bradbury (Electro-Optical Systems, Inc., Pasadena, Calif.). Apr. 1962. Contract AF 33(616)-6549. 62p.

Research on spectrally selective materials and surfaces with particular reference to their application to solar collection and thermionic conversion is described. The work is discussed in three phases: the use of spectrally selective surfaces as solar absorbers; the use of spectrally selective surfaces in thermionic diodes; and the radiative characteristics of phosphor materials. In the first phase, test specimens of metallic oxides on metal substrates were prepared and subjected to thermal equilibrium measurements in a solar test facility. In the second phase, theoretical studies of nickel oxide were made, and experimental measurements of its absorption spectrum and thermionic emission properties were accomplished. The third phase discusses the radiative properties and fluorescence spectrum of benzoylacetonate-europium chelate. (auth)

26954 (BM-RI-6029) PYROLYSIS OF FIVE SALTS OF YTTRIUM, LANTHANUM, AND CERIUM. Louis P. Domingues, Roy L. Wilfong, and LeRoy R. Furlong (Bureau of Mines, College Park Metallurgy Research Center, Md.). Nov. 1961. 22p.

Ammonium, sulfate, carbonate, nitrate, oxalate, and sulfate salts of yttrium, lanthanum, and cerium were analyzed thermogravimetrically. The temperature ranged from room temperature to 1500°C. Each salt was decomposed by heating at a rate of 2.5°C per minute, and some of the salts

were subjected to additional rates of 5 or 10°C per minute. The decomposition sequences were identified, and the temperatures of formation of intermediate compounds and of the oxides were determined. The minimum oxide formation temperature of a given lanthanum salt exceeds that for the similar salt of yttrium, and both exceed that for the same salt of cerium except for one cerium carbonate. Variation of the heating rate indicates a thermal lag in the materials and produces the shift of formation temperatures to higher values and loss of resolution in the weight-loss distribution as the heating rate increases. (auth)

26955 (EIR-22) DIPHÉNYLE DEUTÉRIÉ COMME AGENT DE REFROIDISSEMENT D'UNE PILE NUCLÉAIRE. (Deuterated Diphenyl as a Cooling Agent for a Nuclear Reactor). Jean-Marie Rayroux (Switzerland. Eidgenössisches Institut für Reaktorforschung, Würenlingen). Sept. 1961. 81p.

The results of studies made to determine the behavior of deuterated diphenyl as a reactor coolant are reported. A method is given for the deuteration of heavy hydrochloric acid in the liquid phase catalyzed by anhydrous aluminum chloride. A modification of the method is described for changing it into a counter-current continuous production system. The rate of thermal decomposition of both the ordinary and deuterated diphenyl was studied, and the rates of decomposition and formation of their decomposition products were determined. The deuterated diphenyl has, at 472°C, a decomposition rate 0.71 ± 0.12 times lower than ordinary diphenyl. In both cases the consumption follows a first order law until 80% of the initial substance has disappeared. The isotopic effect in the polymerization rate and gas liberation was measured. A theoretical calculation of the respective doses permitted the effects of neutrons and gamma rays to be determined, respectively. The energy absorption by the atoms of hydrogen, deuterium, carbon, and oxygen was studied by the theory of simple scattering, and the dose curves per unitary flux are established. (J.S.R.)

26956 (JAERI-1033) RATE OF SEDIMENTATION OF THORIUM OXIDE SLURRIES. Yasaburo Yamazaki, Kenzo Yoshida, and Yasuo Akutsu (Japan Atomic Energy Research Inst., Tokyo). 1962. 15p. (In Japanese)

The rate of sedimentation of thorium oxide slurries and several properties of the dry oxide powder were measured at room temperature. The properties included specific gravity, bulk density, average diameter, particle size distribution, and specific surface. Seven brands of commercial thorium oxide including two imported were tested. Thorium oxide particles flocculate when suspended in distilled water and the addition of NaOH to the suspension promotes the flocculation. The relationship of sedimentation rate and solid concentration is different from that of the dispersed system. The rate of sedimentation decreases with concentration markedly at around 7% by volume, and the alkaline additives make the change more sensitive. At lower concentrations it was found that floc is 50 ~ 60 microns in diameter and the void fraction in the floc is 0.90 ~ 0.95. (auth)

26957 (NASA-TN-D-1403) THERMODYNAMIC CONSISTENCY OF SOLUBILITY DATA FOR THE HYDROGEN–HELIUM VAPOR-LIQUID SYSTEM. Irving Brazinsky and Byron S. Gottfried (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1962. 23p.

Data on the solubilities of helium in liquid hydrogen, previously determined at several temperatures and pressures were evaluated for thermodynamic consistency by determination of hydrogen fugacities by two independent techniques. The solubility data are reasonably consistent, although the accuracy of the analysis is somewhat limited by simplifying assumptions. Both the original solubility data and the analysis of thermodynamic consistency are presented. (auth)

26958 (NP-11736) COMMENT CONCERNING THE EFFECT ON THE DIBORANE-PENTABORANE EXCHANGE REACTION OF THE REPORTED DEUTERIUM ISOTOPE EFFECT IN THE DECOMPOSITION OF DIBORANE. Technical Report No. 6. Joyce J. Kaufman (RIAS. Div. of Martin Co., Baltimore). May 1962. Contract Nonr 3471(00). 14p.

The comment concerns data on the ratio of the equilibrium constants for dissociation of B_2D_6 and B_2H_6 from which it was concluded that under identical conditions at the same temperature the BD_3 concentration will be about twice as large as the BH_3 concentration in such a system. Supporting data and comment concerning this conclusion and its chemical basis are presented. (J.R.D.)

26959 (NP-11897) CANADIAN URANIUM RESEARCH FOUNDATION FELLOWSHIP PROGRESS REPORT NO. 6103, JUNE 15–JULY 15, 1961. J. Ciric (Canada. Ontario Research Foundation, Toronto). July 15, 1961. 15p. (CURF-R-16)

Glass formation in the ternary system $Na_2O-UO_3-B_2O_3$ was investigated. The region of glass formation was very similar to that for the system $Li_2O-UO_3-B_2O_3$. It was possible to prepare glasses containing up to 50% UO_3; the ability of UO_3 to enter glass structure decreases with increase in Na_2O content. Densities and refractive indices of the glasses were determined. (auth)

26960 (ORNL-1956) ENTHALPIES AND HEAT CAPACITIES OF SOLID AND MOLTEN FLUORIDE MIXTURES. W. D. Powers and G. C. Blalock (Oak Ridge National Lab., Tenn.). Feb. 1, 1956. Contract W-7405-eng-26. 31p.

The enthalpies and heat capacities of seventeen fluoride mixtures in the liquid state were determined using Bunsen Ice Calorimeters and copper block calorimeters. The fluoride mixtures were composed of the fluorides of two or more of the following metals: Li, Na, K, Be, Zr, and U. The enthalpies and heat capacities of most of the mixtures were studied in the solid state. Estimates of the heat of fusion were also made, and general empirical equations were developed which represent the enthalpies and heat capacities of the fluoride mixtures in the liquid and in the solid state. (auth)

26961 (ORNL-2278) VISCOSITY MEASUREMENTS ON MOLTEN FLUORIDE MIXTURES. S. I. Cohen and T. N. Jones (Oak Ridge National Lab., Tenn.). July 12, 1957. Contract W-7405-eng-26. 48p.

Experimental techniques used for viscosity measurements on molten fluoride mixtures are described, data on viscosity of 36 mixtures are tabulated, and several correlations involving the data are discussed. The 36 mixtures include binary, ternary, and quaternary mixtures of NaF, LiF, KF, RbF, BeF_2, ZrF_4, UF_3, UF_4, and ThF_4. (P.C.H.)

26962 (PAN-282/XVI) UNTERSUCHUNG DES JODIERUNGSPROZESSES VON SPEISESIEDESALZ MIT RADIOAKTIVEM ^{131}J. (Study of Iodination Processes for Common Salt using Radioactive I^{131}). Karol Akerman, Przemyslaw M. Hoffmann, Elzbieta Lelental, and Andrzej PoczynajÏo (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Nov. 1961. 20p.

Investigations concerning iodination of common salt and he formation of iodine compounds in salt were carried out

with the help of I^{131}. Study of the iodination processes covered determination of the quantitative distribution ratio of the microcomponents KIO_3 and NaI between the solid phase of NaCl and the mother liquor as well as an explanation of the distribution mechanism during evaporation of the salt water. It was established that under the given experimental conditions for separation of the NaCl, the iodine compound remains almost completely in solution. The small amount of iodine compound which is fixed in the salt solution is that adhering to crystal surfaces. (tr-auth)

26963 (TID-16400) THERMOPHYSICAL PROPERTIES OF THE LANTHANIDE OXIDES. II. HEAT CAPACITIES, THERMODYNAMIC PROPERTIES, AND SOME ENERGY LEVELS OF SAMARIUM(III), GADOLINIUM(III), AND YTTERBIUM(III) OXIDES FROM 10 TO 350°K. Bruce H. Justice and Edgar F. Westrum, Jr. (Michigan. Univ., Ann Arbor. Dept. of Chemistry). [1961]. Contract [AT(11-1)-1149]. 30p.

Resolution of the electronic and lattice contributions to the heat capacities of two cubic lanthanide oxides over the range 10 to 350°K was achieved by extraction of a lattice contribution from the measured heat capacities of ytterbium(III) oxide below 100°K and gadolinium(III) oxide above this temperature. Above 10°K the magnetic contributions to the heat capacities are Schottky anomalies characteristic of electronic excitation to discrete energy levels occasioned by the splitting of the free-ion ground term by the crystalline electric field. Low-lying energy levels were evaluated albeit tentatively in some instances. By extrapolation below 10°K, practical entropies ($\underline{S}^\circ$) at 298.15°K of Sm_2O_3, Gd_2O_3, and Yb_2O_3 were assigned as 36.1, 36.0, and 31.8 cal $(gfw\ °K)^{-1}$. The corresponding enthalpy increments ($\underline{H}^\circ - \underline{H}^\circ_{10}$) were determined to be 5021, 4424, and 4685 cal $(gfw)^{-1}$. (auth)

26964 (AEC-tr-5253) THE STATE OF PROTACTINIUM IN AQUEOUS SOLUTIONS. VI. ADSORPTION PROPERTIES OF PROTACTINIUM. I. E. Starik, L. D. Sheidina (Sheydena), and L. I. Il'menkova (Ilmenkova). Translated by J. G. Moore (Oak Ridge National Lab., Tenn.) from Radiokhimiya, 4: No. 1, 44-9(1962). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 16388.

26965 (AEC-tr-5254) THORIUM NITRATE. Ed. Chauvenet and Souteyrand-Franck. Translated from Bull. soc. chim. France (4), 47: 1128-31(1930). 6p. (Includes original, 2p.).

An anhydrous salt of thorium nitrate was prepared and the hydrolysis of its hydrates were studied. A pentahydrate was obtained by slow evaporation of a concentrated thorium nitrate solution at 15°C in dry air. From the salt, hydrates less enriched in water were prepared by dessication; the results differed according to whether the pentahydrate was dried in air free of carbonic anhydride or whether in a current of nitric vapors. In the hydrolysis of the nitrate, a substance was formed with the liberation of two nitric acid molecules. The reaction corresponds to the formation of $(NO_3)_2Th(OH)_2$ or $(NO_3)_2ThO$, H_2O. It was also found that hydrolysis is limited to the single transformation. (P.C.H.)

26966 (AECL-1560) THE EQUATION OF STATE FOR HEAVY WATER (D_2O) ACCORDING TO EXPERIMENTALLY DETERMINED p-V-T. A. M. Mamedov. Translated by J. N. Elliott (Atomic Energy of Canada Ltd., Chalk River, Ont.) from Teploenergetika, 7: No. 9, 71-4 (1960). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 2011.

26967 (CEA-tr-R-1579) DÉTERMINATION EXPÉRIMENTALE DES VOLUMES SPÉCIFIQUES DE L'EAU LOURDE. (Experimental Determination of Specific Volumes of Heavy Water). V. A. Kirillin and S. A. Oulibin (Ulybin). Translated into French from Teploenergetika, No. 4, 67-72(Apr. 1959). 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 12832.

26968 (KFK-tr-104) DAS VERHALTEN VON RHODIUM(III) GEGENÜBER. IONENAUSTAUSCHERHARZEN. (Behavior of Rhodium(III) on Ion Exchange Resins). Kikaru Shimojima. Translated into German by Peter Buriks (Kernforschungszentrum, Karlsruhe, Ger.) from Nippon Kagaku Zasshi, 81: 564-7(Apr. 1960). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 10811.

26969 (NP-tr-897) ANHYDROUS BERYLLIUM CHLORIDE. P. Silber. Translated by J. M. Jacobs (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from p.39-47; 52-4 of "Nouveau Traite de Chimie Minerale. Vol. IV. Group II. Beryllium, Magnesium, Calcium, Strontium, Barium, Radium." Paul Pascal, ed. (A publication of Masson et Cie, Paris. 1958). 14p.

Preparations, properties, and reactions with other compounds are summarized. Systems receiving special emphasis include ammoniates of beryllium chlorides, beryllium chloride complexes with organic compounds, beryllium chloride tetrahydrate, aqueous beryllium chlorides, ternary solubility systems, organic solutions of beryllium chloride, and binary beryllium chloride complexes with chloride compounds. (N.W.R.)

26970 (NP-tr-914) THE THEORY OF ELECTROKINETIC PHENOMENA. H. J. Oel. Translated by L. Rowe (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Z. physik. Chem. (Frankfurt), 5: 32-51(1955). 30p.

An attempt was made to establish a theory of electrokinetic phenomena which incorporates the conception of the ζ potential. The theory was derived for dilute solutions. It incorporates Schmid's theory of ion exchange as well as Helmholtz's theory of electrokinetics as limiting cases. It also explains the experimentally observed difference between electro-osmotic and electro-phoretic measurements. The theory was extended to concentrated solutions. It was possible to calculate the electrokinetic mobility of some systems. (M.C.G.)

26971 THE EFFECT OF THE H_2-H_2O ISOTOPE EXCHANGE AT THE SURFACE OF THE $(Pd-H)_{\alpha_2}$ ELECTRODE ON ITS POTENTIAL. Romulus Bucur. Acad. rép. populaire Roumaine, Rev. phys., 6: 269-72(1961). (In German)

In order to investigate the effect of isotope exchange between hydrogen and heavy water on the potential of the $(Pd-H)_{\alpha_2}$ electrode, measurements were made in H_2/H_2SO_4 and $H_2/(D_3PO_4 + H_3PO_4)$. The experimental method is briefly described and the results are discussed. The results lead to the conclusion that the isotope effect on the potential of the $(Pd-H)_{\alpha_2}$ electrode is additive and amounts to ΔE = 0.01992 v for 100 mole % deuterium at 30° C. The isotope exchange-absorption reaction between hydrogen and heavy water in the presence of metallic Pd leads to the same isotope distribution in the metal and in the solution. (J.S.R.)

26972 THERMAL DECOMPOSITION OF THE SELENITES OF SOME RARE EARTH ELEMENTS. Ernesto Giesbrecht, Madeleine Perrier, and Wesley W. Wendlandt

(Universidade, São Paulo, Brazil and Texas Technological Coll., Lubbock). Anais acad. brasil. cienc., 34: 37-43 (1962). (In English)

Potentiometric titration of $NdCl_3$ solution with Na_2SeO_3 solution and conductometric titration of $EuCl_3$ solution with Na_2SeO_3 solution show that $M_2(SeO_3)_3$ is formed. In thermogravimetric analysis of the selenites of La, Pr, Nd, Sm, Eu, and Gd, water of hydration is completely evolved at 230 to 290°C, the anhydrous selenites begin to lose weight at 500 to 700°C, and the oxides were formed at 1100 to 1200°C. Differential thermal analysis of the selenites of La and Sm showed exothermic peaks in the 500 to 600°C range which does not correspond to any weight losses in the thermogravimetric analysis curves. (D.L.C.)

26973 DIRECT IDENTIFICATION OF X-RAY SPECTRA. E. J. Graeber (Sandia Corp., Albuquerque, N. Mex.). Appl. Spectroscopy, 16: 24(1962). (SCR-495)

The use of a transparent overlay for spectrographic charts provides a means of identification of spectra. The transparency is photographically produced from a drawing containing the analytical wavelength lines of interest. (M.C.G.)

26974 SOME NUCLEAR MAGNETIC RESONANCE STUDIES WITH SOLIDS. E. R. Andrew (Univ. Coll. of North Wales, Bangor, Eng.). Arch. sci. (Geneva), 14: 210-18(Sept. 1961). (In English)

An account is given of the anisotropy of spin-lattice relaxation time in some alkali halides. In particular the F^{19} relaxation time in lithium fluoride is described, and it is shown by using crystals enriched in Li^6 that the anisotropy of the fluorine relaxation time largely originates in the anisotropy of the dipolar interactions of the Li^7 nuclei. Experiments on the nuclear magnetic resonance spectrum of solid specimens rotated at high speed are summarized. It is shown that the high speeds of rotation the shape of the central part of the spectrum is a replica of that for the static specimen with the field along the axis used for rotation, but scaled down by a factor $|\frac{1}{2}(3\cos^2\alpha - 1)|$, where α is the angle between the axis and the direction of the applied magnetic field. A cross-relaxation effect induced by rotation is found when a specimen of solid phosphorus pentachloride is rotated at a rate equal to the difference between the two resonance lines of its P^{31} spectrum; the theory of this effect is discussed. (auth)

26975 NUCLEAR RESONANCE IN GASEOUS XENON. D. Brinkmann, E. Brun, and H. H. Staub (Universität, Zurich). Arch. sci. (Geneva), 14: 346-9(Sept. 1961). (In German)

The relaxation times of Xe^{129} and Xe^{131} in natural Xe at high density are measured as a function of the density. In both cases the relaxation time is found to be inversely proportional to the density. The values for Xe^{131} are in agreement with theory. The relaxation time of Xe^{129} may be affected by oxygen impurities. The measured times are much shorter than those that a dipole-dipole interaction predicts. (auth)

26976 INFLUENCE OF $\Delta m = \pm 1$ and $\Delta m = \pm 2$ TRANSITIONS ON THE RELAXATION TIMES OF PURE QUADRUPOLE RESONANCES. Maurice Boyle-Bodin and Sergio Pissanetzky. Arch. sci. (Geneva), 14: 451-5(Sept. 1961). (in French)

Measurements of the relaxation time of Cl^{35} in para-dichlorobenzene show a great disagreement with a particular theory. This theory particularly asserts that the contribution of $\Delta m = \pm 1$ transitions is negligible compared with the $\Delta m = \pm 2$ contribution. The experiments show that the $\Delta m = \pm 1$ transition has the greater effect, but verify one of the theoretical predictions concerning the effects of the $\Delta m = \pm 2$ transitions. (auth)

26977 STUDIES ON THE RELATION OF CATALYTIC PROPERTIES OF $LiAlH_4$ AND ITS DECOMPOSITION PRODUCTS AND THEIR MAGNETIC RESONANCE PROPERTIES. Ioan Ursu and John Turkevich. Arch. sci. (Geneva), 14: 498-522(Sept. 1961). (In English)

$LiAlH_4$ and its thermal decomposition products contain centers that are active as catalysts for hydrogen–deuterium exchange and for deuterium exchange with the hydrogen atoms of the compounds. The natures of these centers are characterized by means of electron spin resonance and nuclear magnetic resonance studies. Moreover, the effect of ultraviolet irradiation on the rates of the exchange reactions in question is determined. (T.F.H.)

26978 THE TRANSPLUTONIUM ELEMENTS. [PART] I. W. Kraak (Reactor Centrum Nederland). Atoomenergie, 4: 91-9(May 1962). (In Dutch)

An exposition is given on the special place that the actinides have in the periodic system in analogy with the position of rare earths. Then the discovery and the preparation of each transplutonium element is described. (tr-auth)

26979 THERMODYNAMIC PROPERTIES OF SOME METAL HEXAFLUORIDES. G. Nagarajan (Annamalai Univ., Annamalainagar, South India). Bull. soc. chim. Belges, 71: 77-91(1962). (In English)

The thermodynamic properties such as heat content, free energy, entropy, and heat capacity were calculated for the molecules MoF_6, WF_6, IrF_6, UF_6, NpF_6, and PuF_6 for the ideal gaseous state at one atm pressure up to a rigid rotator, harmonic oscillator approximation. The values were calculated for the temperature range from 50 to 1600°K by using the observed fundamental frequencies for the above molecules. (auth)

26980 PREPARATION OF THIN ELECTRODEPOSITS OF ACTINIDES FROM AQUEOUS SOLUTIONS OF (ETHYLENEDIAMINE)TETRAACETIC ACID. J. Fuger (Université de Liegé). Bull. soc. chim. Belges, 71: 134-41(1962). (In French)

The cathodic electrodeposition of several actinide elements from aqueous solutions of EDTA partially neutralized with ammonia is studied. On platinum cathodes, the deposited films are thin, adherent, and reasonably uniform. A yield of 90 to 95% can be achieved under suitable conditions. The rate of deposition is the same for tripositive transplutonium elements, but plutonium deposits preferentially at the beginning of the electrolysis; on the other hand, the uranyl ion has a deposition rate lower than the transplutonium elements. The presently described technique is not limited to tracer scale since submicrogram and microgram amounts of various elements can produce satisfactory deposits. For plutonium, deposits up to 300 micrograms/cm^2 were obtained, but with a limiting yield of 70%. (auth)

26981 INVESTIGATION OF THE URANIUM(VI) COMPLEXES WITH α-HYDROXY ACIDS BY EXTRACTION METHODS. J. Starý and V. Balek (Tschechische Technische Hochschule, Prague). Collection Czechoslov. Chem. Communs., 27: 809-15(Apr. 1962). (In German)

On the bases of U(VI) extraction with 0.100 M dibenzoylmenthane solution as a function of pH and of concentration of glycolic, lactic, and α-hydroxyisobutyric acids, the composition and stability constants of U(VI) complexes with these α-hydroxy acids were determined. It was established that U(VI) in the aqueous phase forms complexes of the type UO_2B^+, UO_2B_2, and $UO_2G_3^-$. From the values of the stability constants calculated by the Leden limiting method, it could

be concluded that the acids investigated formed chelate complexes with U(VI). (tr-auth)

26982 HYDROLYSIS OF URANYLS. II. MAGNETOCHEMICAL INVESTIGATION. V. Baran and M. Tympl (Inst. for Nuclear Research, Czechoslovak Academy of Science, Rez). Collection Czechoslov. Chem. Communs., 27: 1340-4(May 1962). (In German)

The magnetic susceptibility of the uranyl ion was measured in dependence on the hydrolytic complex formation. The results are tabulated. (J.S.R.)

26983 THE U–U_2–UH_3–AND U–D_2–UD_2 EQUILIBRIA AND THE DECOMPOSITION RATES OF UH_3 AND UD_3. Michel Destriau and Jocelyn Seriot (Institut d'Etudes Nucleaires, Laboratoire de Chimie Generale, Algiers). Compt. rend., 254: 2982-4(Apr. 16, 1962). (In French)

The measurements of the equilibrium pressures for the equilibria U–H_2–UH_3 and U–D_2–UD_3 give the heats of formation of UH_3 and UD_3. The measurements of the rates of dissociation of these two compounds give the heats of activations; the value found for the dissociation of UH_3 is much larger than that found for the dissociation of UD_3. (tr-auth)

26984 THE HYDROLYSIS OF URANIUM MONOCARBIDE. Guy Baudin, Jean Besson, Pierre Blum, and Jean Spitz (Centre d'Etudes Nucléaires, Grenoble, France). Compt. rend., 254: 4179-81(June 13, 1962). (In French)

The hydrolysis in neutral or acid medium of the carbide UC leads to a complex mixture of saturated hydrocarbons with some ethylene. In the presence of an oxidant, a sharp increase in the concentration of unsaturated hydrocarbons along with the appearance of C_3 and C_4 ethylenes, but no appearance of acetylenes, is observed. The reaction mechanism proposed takes these facts into consideration. (tr-auth)

26985 METAL + METAL HALIDE SYSTEMS FOR LANTHANUM CERIUM AND PRASEODYMIUM IODIDES. J. D. Corbett, L. F. Druding, W. J. Burkhard, and C. B. Lindahl (Ames Lab., Ames, Iowa). Discussions Faraday Soc., 32, 79-83(1962). (IS-307)

The metal + metal tri-iodide systems for lanthanum, cerium, and praseodymium are presented in the form of phase diagrams. In contrast to the behavior of the respective chlorides, all three of these systems show the formation of a stable di-iodide, higher melting than the tri-iodide, plus a stoichiometric intermediate phase with an iodine to metal ratio between 2.4 and 2.5. The stability on melting and the melting points decrease from LaI_2 to PrI_2. The high conductivities ($>1 \times 10^3$ ohm^{-1} cm^{-1}) of the black to bronze di-iodides and the small molar susceptibility (2×10^{-4} e.m.u.) of LaI_2 indicate the presence of tripositive metal cations plus "metallic" lattice electrons, $M^{3+}e(I^-)_2$. This is in contradistinction to the salt-like neodymium di-iodide but similar to the monosulfides and dicarbides of these and neighboring elements. The nature of the solids and their possible conduction behavior in the liquid state are briefly considered. (auth)

26986 THE INTERACTION OF A FREE METHYL RADICAL WITH THE HYDROXYL HYDROGEN OF TERTIARY BUTYL ALCOHOL. THE ROLE OF THE HYDROGEN BOND. I. V. Berezin, K. Vatsek, and N. F. Kazanskaya (Moscow Univ., USSR). Doklady Akad. Nauk S.S.S.R., 144: 139-42(May 1, 1962). (In Russian)

The weak reactivity of hydroxyl hydrogen of tertiary butyl alcohol with free methyl radicals is due not to the high strength of the OH bond (100 to 104 kcal/mol), but is due to hydrogen bonding between alcohol molecules. The rate of reaction of hydroxyl hydrogen with free methyl radicals was determined with respect to the rate of reaction of free methyl radicals with CH groups in n-heptane from the following competing reactions: (1) $(CH_3)_3$ COT + $CH_3^\bullet \xrightarrow{k_{OT}}$ CH_3T + $(CH_3)_3CO^\bullet$, and (2) n-C_7H_{16} + $CH_3^\bullet \xrightarrow{k_{CH}}$ CH_4 + $C_7H_{15}^\bullet$. The ratio of the reaction rate constants k_{OT}/k_{CH} increased with decreasing concentration of alcohol, and tended to a limiting value of 0.144. The most satisfactory explanation of this behavior is that the hydroxyl hydrogen atoms of monomeric alcohol molecules, and not of associated alcohol molecules, react with the methyl radicals. The degree of dissociation of the alcohol into monomeric molecules was 7% at an alcohol concentration of 2.28 mols/l, and 99.3% at 0.0009 mols/l. The degree of dissociation of the alcohol at various temperatures can be determined from the ratio k_{OT}/k_{CH} at the temperature in question. It was found that $k_{OT}/k_{CH} = 42 \exp(-2400/RT)$. (TTT)

26987 CHEMILUMINESCENCE KINETICS AND A STUDY OF THE REACTIONS INVOLVING THE OXIDATION OF A HYDROCARBON IN SOLUTION. R. F. Vasil'ev (Inst. of Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 143-6(May 1, 1962). (In Russian)

Chemiluminescence was found to occur during the oxidation of a hydrocarbon in a system involving reactions between radicals. A decrease in chemiluminescence is observed when an inhibitor is added to react with the intermediate radical, or when the oxygen in the system is used up (replacement of the peroxide radicals $RO_2^\bullet$ by hydrocarbon radicals $R^\bullet$). The initial luminescence intensity returns, as the inhibitor is used up. The luminescence intensity is determined in the final analysis by the concentrations of the reagents, by the reaction rate constants of the elementary reactions, and by the luminescence yield. Thus, the luminescence intensity accompanying the oxidation of ethylbenzene at 60°C in benzene solution is affected by the amount of dissolved oxygen in solution, and by the presence of indole which acts as an inhibitor. The change in the kinetics of chemiluminescence in oxidation reactions can be used to elucidate the reaction mechanism, to measure the ratio of two reaction rates, and to judge the relative effectiveness of various inhibitors. The rate of initiation of the reaction (or the solubility of oxygen) is the only quantitative characteristic of the system which must be known before carrying out the experiment. (TTT)

26988 A STUDY OF THE KINETIC REGULARITIES OF A COMPLEX, CHAIN REACTION IN AN OPEN SYSTEM AS A METHOD OF DETERMINING THE RATE OF FORMATION AND OF CONSUMPTION OF AN INTERMEDIATE PRODUCT. I. P. Skibida, Z. K. Maizus, and N. M. Emanuel' (Inst. of Chemical Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 170-2(May 1, 1962). (In Russian)

In a simple consecutive reaction where A $\xrightarrow{k_1}$ B $\xrightarrow{k_2}$ C, the reaction rate constants can be determined by feeding not pure A, but a mixture of A and B of the proper composition to a continuous reactor. The concentration of radicals which initiate the reaction is kept constant by changing the stationary concentration of the substance B. The ratio k_1/k_2 can be obtained from a plot of $[B]_0$ versus $[B]_1 - [B]$. The rate of formation and consumption of alcohol was determined in the oxidation of decane with O_2 in a continuous reactor. The stationary concentration of peroxide did not change on feeding pure decane, and decane containing 0.207 and 0.296 mols/l of decanol-2. The addition of alcohol did not affect the concentration of radicals in the system. The ratio k_1/k_2 was found to be 2.5. The introduction of alcohol to the feed did not change the stationary concentration of acids, but did increase the stationary concentration of ke-

tones in the system. This method is a way of determining the rate of formation and consumption of an intermediate product in a complex, chain reaction. (TTT)

26989 A STUDY OF THORIUM COMPLEXING BY MEANS OF ION EXCHANGE, INFRARED SPECTROSCOPY AND NUCLEAR MAGNETIC RESONANCE. I. Geletseanu and A. V. Lapitskiĭ (Moscow Univ., USSR). Doklady Akad. Nauk S.S.S.R., 144: 573-5(May 21, 1962). (In Russian)

Thorium complexing by malic acid, trihydroxyglutaric acid, tartaric acid, α-hydroxyisobutyric acid and mandelic acid was followed by means of ion exchange at various concentrations of complexing agent and pH. The instability constants, and composition of the complexes are listed. The average effective charge on the complex was determined by ion exchange. Polynuclear thorium complexes with hydrogen bridges were formed with malic acid, but not with the rest of the organic complexing agents. A number of thorium complexes were synthesized in acid solution, and analyzed for C, H, H_2O, and ThO_2. Structural formulas are presented. The infrared spectra of these compounds show that thorium is bound to the complexing agent by means of the carboxyl group and not by means of the hydroxyl group. The nuclear magnetic resonance experiments indicate the occurrence of polymeric association in thorium acetate. (TTT)

26990 RADIATION-CHEMICAL SYNTHESIS OF ORGANOSILICON AND ORGANOSILICONFLUORINE COMPOUNDS. A. V. Zimin, A. D. Verina, L. P. Sidorova, and A. V. Gubanova (L. Ya. Karpov Physics-Chemistry Inst., USSR). Doklady Akad. Nauk S.S.S.R., 144: 576-8(May 21, 1962). (In Russian)

Chlorosilane derivatives were prepared by irradiating with Co^{60} gamma rays a mixture containing C_nH_{2n}, $C_nH_{2n-m}F_m$, C_6H_6, or C_6H_5Cl as one component, and $HSiCl_3$, H_2SiCl_2, CH_3SiHCl_2 or $C_2H_5SiCl_2H$ as the other component. The irradiated mixture was separated into various fractions by multiple rectification in vacuum at temperatures of −40 to 250°C. The separated fractions were run for C, H, Cl, F, and Si, and also for hydrolyzable chlorine and fluorine. The molecular weight, density, and refractive index were also determined in order to establish the nature and structure of the new compounds formed. Synthesis of organosilicon compounds by this method is possible if during irradiation the rate of polymerization of the olefine is less than its rate of reaction with the chlorosilane. A maximum G yield of the end product was obtained at a mole ratio of one molecule of olefine per atom of hydrogen on the chlorosilane. Increasing the temperature from +20° to +70°C did not change the G yield of the perfluoro-(alkyldialkyl)-chlorosilanes (G = 80 to 100 moles/100 ev), or the G yield of the arylchlorosilanes (G = 6 to 10 moles/100 ev), but the G yield of the (alkyl-dialkyl)-chlorosilanes increased from 8 to 10 moles/100 ev at +20°C to 160 to 210 moles/100 ev at 70°C because of the presence of a chain reaction. The compounds $(CH_3HF_6)SiCl_3$*, $(CH_3HF_6)_2SiCl_2$*, $(CH_3HF_6)CH_3SiCl_2$,* $(CH_3HF_6)C_2H_4SiCl_2$.* $(C_3H_7)SiHCl_2$, $(C_3H_7)_2SiCl_2$, $(C_3H_7)CH_3SiCl_2$, $C_3H_7SiCl_3$, $(C_3H_5)_2SiCl_2$ and $(C_3H_5)CH_3SiCl_2$ were formed with a high G yield (the star indicates a new compound). (TTT)

26991 THE SYNTHESIS OF A NUMBER OF ORGANIC DERIVATIVES OF POLYVALENT ASTATINE. V. D. Nefedov, Yu. V. Norseev, Kh. Savlevich, E. N. Sinotova, M. A. Toropova, and V. A. Khalkin (Leningrad Univ., USSR). Doklady Akad. Nauk S.S.S.R., 144: 806-9(June 1, 1962). (In Russian)

The astatine isotopes At^{210} and At^{211} were recovered in pure form from the spallation products of a thorium target irradiated with 660 Mev protons. In order to synthesize $PhAtCl_2$, a solution of KI containing At was added to an aqueous solution of diphenyl iodochloride. The precipitate was centrifuged and decomposed by heating at 170°C for 5 minutes according to the scheme: $Ph_2I.I(At) \rightarrow 2PhI(At)$. The PhI(At) compound was chlorinated to $PhI(At)Cl_2$. Fractionation by paper chromatography showed that the β-active peak of benzene iodochloride and the α-active peak of the astatine compound coincided. The $PhI(At)Cl_2$ compound did not change its specific activity even after several recrystallizations from chloroform. The $Ph_2I(At)Cl$ compound was synthesized as follows: $PhI(At)Cl_2 + Ph_2Hg \rightarrow Ph_2I(At)Cl + HgPhCl$. The product $Ph_2I(At)Cl$ was separated from the starting material $PhI(At)Cl_2$ by paper chromatography. The $PhI(At)O_2$ compound can be prepared by heating $PhI(At)Cl_2$ with 2 ml of 50% NaOH and 0.5 ml of acetic acid. On cooling, the $PhI(At)O_2$ compound separates out as an amorphous precipitate. Thus, it was shown that classical methods of organic synthesis can be used to prepare organic derivatives of polyvalent astatine. (TTT)

26992 REPLACEMENT OF FLUORINE BY CHLORINE AND ITS SALTS AT HIGH TEMPERATURES. I. N. Sheiko, A. I. Voronina, and V. V. Smeshkov (Inst. of General and Inorganic Chemistry, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. R.S.R., No. 5, 613-15 (1962). (In Ukrainian)

It was confirmed experimentally that chlorine replaces fluorine in fluorides of alkaline and alkaline-earth metals (having ionic binding) at high temperatures, with the formation of chlorides, whereas in the case of aluminum and zirconium fluorides (having covalent binding) this process does not occur. (auth)

26993 THERMAL DECOMPOSITION OF CERTAIN RARE EARTH ELEMENTS. A. A. Avakin (Ural Branch of the Academy of Sciences, Sverdlovsk, USSR). Izvest. Sibir. Otdel. Akad. Nauk S.S.S.R., No. 1, 49-54(1962). (In Russian)

Kinetic and x-ray diffraction analyses of the thermal decomposition of La, Nd, Ga, Pr, Eu, Gd, Yb, and Y sulfates at 950 and 1050°C and of oxysulfates at 1300°C showed that in transition to oxysulfates the rare earth sulfates form solid solutions. (tr-auth)

26994 MELT DIAGRAM OF In−Cl SYSTEMS. V. N. Fadeev and E. S. Petrov (Inst. of Chemistry and Metallurgy, Siberian Branch of the Academy of Sciences, Novosibirsk, USSR). Izvest. Sibir. Otdel. Akad. Nauk S.S.S.R., No. 1, 94-7(1962). (In Russian)

The melting diagram of In-Cl systems indicate the presence of three congruently (InCl, In_2Cl_3, and $InCl_2$) and one incongruently ($InCl_2$) melting compounds. A special device was developed for simultaneous differential analysis of six specimens. (R.V.J.)

26995 ZONAL CRYSTALLIZATION OF RARE EARTHS WITH MOLTEN SALTS. V. K. Val'tsev, E. D. Oziashvilli, and L. K. Solov'ev (Inst. of Inorganic Chemistry, Siberian Branch of the Academy of Sciences, Novosibirsk, USSR). Izvest. Sibir. Otdel. Akad. Nauk S.S.S.R., No. 2, 53-7(1962). (In Russian)

Zonal crystallizations of two rare-earth mixtures: (1) 2.5% La, 8 to 11% Pr, 86.84% Nd, and 2 to 3% Sm and (2) 3.66% Pr, 29.3% Sm, 1.0% Eu, 24.3% Gd, 5.77% Dy, 0.5% Ho, 4.7% Er, 25.2% Y, and less than 1% of La, Tb, and Y in low-melting ammonium nitrates and rhodonides and high-melting magnesium and barium chlorides were studied. (R.V.J.)

26996 OPTICAL PROPERTIES OF RARE EARTH FLUORIDES OF CERIUM GROUP. L. B. Batsanova and G. N. Grigor'eva (Inst. of Inorganic Chemistry, Siberian Branch of the Academy of Sciences, Novosibirsk, USSR). Izvest. Sibir. Otdel, Akad. Nauk S.S.S.R., No. 2, 115-18 (1962). (In Russian)

Densities and refraction indices were measured and molar refractions were calculated for La, Pr, Sm, and Eu fluorides. The absorption spectra show no perceptible infrared absorption at 600 cm^{-1}. The maximum absorption was found at 400 cm^{-1}. (R.V.J.)

26997 THE TRITIUM β-RAY SENSITIZED EXCHANGE OF DEUTERIUM ATOMS WITH METHANE. Richard F. Firestone, Charles F. Lemr, and Gerald J. Trudel (Western Reserve Univ., Cleveland). J. Am. Chem. Soc., 84: 2279-84(June 20, 1962).

The exchange of deuterium atoms with methane in mixtures of TD, D_2, and traces of methane was studied at temperatures from −196 to 225° at D_2 pressures near 1 atmosphere. CH_3D was the only exchange product detectable below 12% conversion, the more highly deuteriated methanes being formed as secondary products by exchange of CH_3D, CH_2D_2, etc. A chain mechanism was operative about 123° and proceeded with an apparent activation energy of about 16 kcal/mole. No evidence in support of H-atom abstraction was found, and a virtual absence of CH_3 radicals was indicated. Below 123° the exchange proceeded with an apparent activation energy of about 2 kcal/mole, presumably via an ion-molecule chain mechanism. (auth)

26998 THE EFFECTS OF DEUTERIUM SUBSTITUTION ON THE RATES OF ORGANIC REACTIONS. VII. SECONDARY EFFECTS ON THE SOLVOLYSIS OF 3-HALO-3-METHYL-1-BUTYNES. V. J. Shiner, Jr., Joseph W. Wilson, Guenther Heinemann, and Norman Solliday (Indiana Univ., Bloomington). J. Am. Chem. Soc., 84: 2408-11 (June 20, 1962).

The isotopic variant of 3-bromo-3-methyl-1-butyne (I) having all six hydrogens of the two methyl groups replaced by deuterium, undergoes the SN1, carbonium ion solvolysis reaction in "80%" ethanol at 25° 1.84 times slower than I itself. The second-order hydroxide ion-promoted solvolysis, which is an SN1 reaction of the conjugate base, is slowed, by this deuterium substitution, by only a factor of 1.31. This is apparently most reasonable explained in terms of differing demand for hyperconjugation in the two closely related transition states. Replacement of the acetylenic hydrogen by deuterium has very little if any influence on the solvolysis rate of the analogous chloro compound. This represents a "vinylog" of α-deuterium substitution and the absence of any isotope effect is consistent with the accepted steric origin of the α-deuterium isotope effect. (auth)

26999 KINETIC ISOTOPE EFFECTS OF DEUTERIUM OXIDE ON SEVERAL α-CHYMOTRYPSIN-CATALYZED REACTIONS. Myron L. Bender and Gordon A. Hamilton (Illinois Inst. of Tech., Chicago). J. Am. Chem. Soc., 84: 2570-6(July 5, 1962).

The kinetics of several reactions catalyzed by α-chymotrypsin were determined in D_2O as solvent, and the results were compared with the kinetics of the same reactions in H_2O as solvent. By a suitable choice of substrates it was possible to estimate the effect of D_2O on the binding of the substrate to the enzyme, acylation of the enzyme, and deacylation of the acyl-enzyme intermediate. The substrate p-nitrophenyl trimethylacetate was used for studying the acylation reaction, and trans-cinnamoyl-α-chymotrypsin and trimethylacetyl-α-chymotrypsin were used for studying the deacylation reaction. A sizable isotope effect was observed for both the acylation and deacylation reactions (k^H/k^D = 2 to 3). The kinetics of the hydrolysis of N-acetyl-L-tryptophan methyl ester were also compared in D_2O and H_2O and it was observed that at high substrate concentrations the limiting rate constant is greater in H_2O than in D_2O by a factor of 2.83. The results indicate a rate-determining proton transfer in the catalytic steps of the enzymatic reaction. (auth)

27000 ELECTROCHEMICAL REDUCTION OF PYRIMIDINE, CYTOSINE AND RELATED COMPOUNDS: POLAROGRAPHY AND MACROSCALE ELECTROLYSIS. David L. Smith and Philip J. Elving (Univ. of Michigan, Ann Arbor). J. Am. Chem. Soc., 84: 2741-7(July 20, 1962).

The electrochemical reduction of pyrimidine and certain derivatives was investigated over the normal pH range by polarography, coulometry, and macroscale electrolysis. Reduction products were examined chemically, polarographically, and spectrophotometrically. Pyrimidine was first reduced at the 3,4-position in a 1e process to a free radical, which may dimerize or be reduced (1e process) to 3,4-dihydropyrimidine; the latter can be further reduced (2e process) to tetrahydropyrimidine. The 2-amino- and 2-amino-4-methylpyrimidines was reduced in two 1e steps, first to a free radical and then to the 3,4-dihydro derivative. 4-Amino-2,6-dimethylpyrimidine gave a single 4e wave, which likely involved 2e reduction to the 3,4-dihydro compound followed by deamination to 2,6-dimethylpyrimidine, which was reduced (2e process) to 2,6-dimethyl-3,4-dihydropyrimidine. Cytosine (4-amino-2-hydroxypyrimidine) underwent a 3e reduction, which probably involved 2e reduction of the 3,4-N=C bond, deamination to form 2-hydroxypyrimidine and 1e reduction of the latter to a free radical which dimerized. 2-Hydroxypyrimidine itself showed only 1e reduction. The dihydro and tetrahydro products were unstable in aqueous solution; pseudo-first-order rate of disappearance is shown by the two compounds examined. In general, 4-aminopyrimidines having the 3,4-position hydrogenated deaminated readily to generate the reducible 3,4-N=C bond. (auth)

27001 INTERPAIR NUCLEAR MAGNETIC RELAXATION IN HYDRATED CRYSTALS. D. F. Holcomb and B. Pedersen (Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 36: 3270-8(June 15, 1962).

A set of pulsed rf spin-lattice relaxation time measurements was made on the proton system in $CaSO_4 \cdot 2H_2O$. The measurements were performed at several crystal orientations, and over a temperature range from 160 to 365°K. A more limited set of measurements was performed on the proton and Li^7 systems in $Li_2SO_4 \cdot H_2O$ powder. In both systems there was a strong relaxation mechanism arising from dipolar motion. It appeared that this relaxation arises from 180° flips of the water molecules. The T_1 data gave a motional activation energy of 6.2 ± 0.5 kcal/mole in $CaSO_4 \cdot 2H_2O$, a reasonable energy for the two hydrogen bonds which must be broken in the postulated motion. Steady-power absorption line measurements showed essentially no narrowing of the proton resonance, in spite of the fact that the characteristic motional frequency reaches the Larmor frequency, 9.0 Mc/sec, at about 230°K. Interpair, rather than intrapair, interactions were responsible for the relaxation. A simplified calculation using only two interacting pairs in $CaSO_4 \cdot 2H_2O$ indicated that the observed minimum value of T_1 and the lack of appreciable motional narrowing is reasonably accounted for by the proposed mechanism. A similar calculation for the Li^7 system in $Li_2SO_4 \cdot H_2O$ also yielded satisfactory agreement with exper-

iment. The results presented demonstrate the importance of an examination of details of internuclear interactions in a particular crystal in the interpretation of motional effects in magnetic resonance experiments. (auth)

27002 EFFECT OF ADSORPTION BEDS OF IONIZED MOLECULES ON THE INTENSITY OF THE α RADIATION EMITTED BY AQUEOUS SOLUTIONS OF POLONIUM CHLORIDE (PRELIMINARY STUDY). Lisbeth Ter Minassian-Saraga and Annita Luzzati (Faculté des Sciences, Paris). J. chim. phys., 59: 481-4(May 1962). (In French)

When an aqueous solution of a cationic surface agent (substituted derivative of quaternary ammonium compounds) contains traces of $PoCl_6^{2-}$, these are accumulated at the surface. An experimental method for the direct measurement of the number of these ions is reported. The effect of the concentration in solution of the surface agent on the adsorption of $PoCl_6^{2-}$ is studied. (tr-auth)

27003 ELECTROMETRIC STUDIES ON THE PRECIPITATION OF HYDROUS OXIDES OF SOME QUADRIVALENT CATIONS. PART II. PRECIPITATION OF THORIUM HYDROXIDE FROM SOLUTIONS OF THORIUM SALTS. R. P. Singh and N. R. Banerjee (Univ. of Delhi). J. Indian Chem. Soc., 39: 255-9(Apr. 1962). (In English)

Precipitation of thorium hydroxide from thorium sulfate, chloride, and nitrate solutions by sodium hydroxide showed that when equilibria are attained, the precipitates consist of basic salts having compositions $Th(OH)_{3.14}(SO_4)_{0.43}$, $Th(OH)_{3.12}Cl_{0.88}$, and $Th(OH)_{3.7}(NO_3)_{0.3}$. The anion penetration is practically of the same order in the case of sulfate and chloride, but in the case of nitrate, it is much less. Using baryta in the case of thorium sulfate solutions, it was found that although a basic salt of about the same composition is precipitated initially, it gives up its sulfate ions on addition of more of baryta, leaving behind almost pure hydrous oxide of thorium. (auth)

27004 FORMATION OF THORIUM-SULPHOSALICYLATE COMPLEX. D. D. Sharma and Arun K. Bhattacharya (Univ. of Sauger, India). J. Indian Chem. Soc., 39: 299-300(Apr. 1962). (In English)

The reactions between sulfosalicylic acid and thorium ions was studied by applying the monovariation method using equimolar solutions of thorium nitrate and sulfosalicylic acid. The conductance and pH data were plotted against volume of ligand. Dissociation constants were determined by Job's method. (M.C.G.)

27005 THE EFFECT OF Fe^{3+} AND V^{5+} IONS ON THE KINETICS OF THE OXIDATION OF U^{4+} BY CHLORATES IN PERCHLORIC AND SULFURIC ACID SOLUTIONS. L. A. Fedorova and E. A. Kanevskii. Kinetika i Kataliz, 3: 332-5(May-June 1962). (In Russian)

It was reported previously (Radiokhimiya, 2: 559(1960)) that the oxidation level is the controlling factor in the oxidation of U^{4+} ions in solutions containing perchloric or sulfuric acid. This problem was further investigated by examining the influence of ions variable valence levels, such as Fe^{3+} and V^{5+}. The oxidation was carried out with 0.1M and 0.01M $KClO_3$ solutions, adding various amounts of the ions studied while the ionic strength was kept at $\mu = 1.0$. It was found that even small additions of Fe^{3+} increase the oxidation rate; in the range from 0.008 to 0.04 moles/liter rate was increased by factors from 75 to 300. The oxidation was found to be a zero-order reaction with a definite induction period. The effect of V^{5+} ions was tested with additions in the 0.00001 to 0.001M range: even small amounts were found to have a catalytic effect, without however changing the order of the reaction. The effect of V^{5+} ions was found to be stronger than that of the Fe^{3+} ions. (TTT)

27006 BORIDES OF RUTHENIUM, OSMIUM AND IRIDIUM. B. Aronsson, E. Stenberg, and J. Aselius (Univ. of Uppsala). Nature, 195: 377-8(July 28, 1962).

A review is presented on the crystal structures of Ru, Os, and Ir borides. The phases originally reported by Buddery and Welch (1951) are identified with the more completely characterized intermediate phases. (D.L.C.)

27007 NOTES ON ISOTOPIC EXCHANGE REACTIONS. II. STOCHASTIC MODEL FOR ISOTOPIC EXCHANGE REACTION. Kenji Ishida and Yutaka Yamamoto (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 322-26(May 1962). (In English)

The stochastic approach to an isotopic exchange reaction can derive the distribution law for the number of reacting molecules in the equilibrium state, and it is discussed in comparison with the usual deterministic method. This model is also used to the probabilistic representation of the equilibrium constant. (auth)

27008 THIN CATION-EXCHANGE FOILS. Sven Bjoernholm and C. Michael Lederer (Univ. of California, Berkeley). Nuclear Instr. & Methods, 15: 233-6(Apr. 1962). (In English)

Treatment of commercial polystyrene sheets with fuming sulfuric acid produced a thin layer of cation exchanger. The ion exchange capacity of the layer was measured by an isotope dilution procedure which utilizes Th^{228} and Th^{232}. At the same time the thickness was found from the yield of Ra^{224} which escapes from the foils as α-decay recoils. A specific capacity of 5.6 milliequivalents per gram can readily be obtained, and the thickness can be varied from a few to several hundred micrograms/cm^2. The foils were used for preparation of α sources. (auth)

27009 ULTRA-VIOLET ABSORPTION SPECTRA AND HIGHER EXCITED STATES OF Nd^{3+} IN $LaCl_3$ AT 77°K. R. M. Agrawal, R. K. Asundi, R. C. Naik, D. Ramakrishman, and Shobha Singh (Atomic Energy Establishment, Trombay, India). Proc. Indian Acad. Sci., Sec. A, 55: 325-9(June 1962). (In English)

An extension was made towards shorter wavelengths of the absorption spectrum of Nd^{3+} employing a 5% Nd^{3+} doped $LaCl_3$ crystal. Five new groups of lines were recorded and the analysis and interpretation of one of these groups, viz., group O between 3010 and 3023 Å are given. The lines observed in this group are shown to be due to transitions from the ground level ($^4I_{9/2}$) stark components ($\mu = 5/2$, $1/2$, and $3/2$) to the two stark components ($\mu = 3/2$, $1/2$) of $^2D_{5/2}$ level at about 33200 cm^{-1}. (auth)

27010 ON PLUTONYL CARBONATE COMPLEXES. A. D. Gel'man, A. I. Moskvin, and V. P. Zaitseva. Radiokhimiya, 4: 154-62(1962). (In Russian)

The solubility of ammonium diplutonate in $(NH_4)_2CO_3$ solutions was determined, and the compositions and instability constants of $[PuO_2(CO_3)(OH)_2 \cdot 2H_2O]^{2-}$, $[PuO_2(CO_3)(OH) \cdot 3H_2O]^-$, and $[PuO_2(CO_3)_2 \cdot 2H_2O]^{2-}$ were calculated. The approximate instability constants and PuO_2CO_3 solubility products were found. $NH_4[PuO_2CO_3(OH) \cdot 3H_2O]$ was separated from dark red carbonate solutions as well as carbonate complexes with MO_2^{2+} : addend ratios 1 : 2 and 1 : 3. An analysis of ammonium plutonyl carbonate solubility in $(NH_4)_2CO_3$ solutions of various concentrations and absorption spectra of the resulting green solutions indicated the formation of a carbonate complex with MO_2^{2+} : addend ratio = 1 : 2. (R.V.J.)

27011 DETERMINATION OF THE COMPOSITION AND INSTABILITY CONSTANTS OF Am CITRATE AND TARTRATE COMPLEXES BY ION EXCHANGE. A. I. Moskvin, G. V. Khalturin, and A. D. Gel'man. Radiokhimiya, 4: 162-6(1962). (In Russian)

In citrate solutions Am^{3+} forms complex ions $[Am(H_2\ Cit)_3]^0$, $[Am(Cit)]^0$, and $[Am\ (Cit)_2]^{3-}$ with instability constants (at $\mu = 1$) of 5.1×10^{-3}, 7.7×10^{-8}, and 1.0×10^{-14}, respectively. In tartrate solutions it forms complex ions of $[Am(tart)_2]^-$ and $[Am(tart)(H\ tart)]^0$ with instability constants of 1.9×10^{-11} and 2.1×10^{-6}. The composition of Am^{3+} complexes depends on the concentrations of anions and hydrogen ions. (R.V.J.)

27012 INVESTIGATIONS OF COMPLEX COMPOUNDS OF Nd AND Yb WITH GLUCONIC ACID BY ION EXCHANGE. N. A. Kostromina. Radiokhimiya, 4: 167-75 (1962). (In Russian)

The composition and stability of gluconate complexes with microquantities of Nd^{147} and Yb^{175} (10^{-7} m/l) and gluconate ion concentrations from 0.5×10^{-2} to 1×10^{-1}M were studied by ion exchange. The instability constants of MA_n complexes (M = Nd and Yb, $\underline{n}$ = 1 to 6) were determined. The complex stability (except MA_6^{3-}) increased from Nd to Yb. (R.V.J.)

27013 DIFFUSION OF Sr^{90} INTO SOIL AND SAND. V. M. Prokhorov. Radiokhimiya, 4: 205-11(1962). (In Russian)

A differential diffusion equation was derived for multiphase media. For the case of a linear adsorption isotherm the diffusion coefficient does not depend on concentration. The numerical diffusion coefficients for Sr^{90} in strongly adsorbing soil and in quartz sand were measured. It was found that the distribution coefficient for Sr^{90} in humid soil is considerably smaller than in a water suspension of the same soil. (R.V.J.)

27014 SORPTION OF LONG-LIFE FISSION PRODUCTS IN SOILS AND CLAY MINERALS. II. SORPTION OF Ce^{144} BY SOILS. Yu. A. Kokotov, R. F. Popova, Ching-chick Liu, and Shik-ch'i Mao. Radiokhimiya, 4: 227-8 (1962). (In Russian)

Sorption of Ce^{144} by two types of soils (black earth and podzolic level soil) was studied in various complexing salt solutions. The sorption of Ce^{144} in saltless alkali solution is very weak due to Ce^{3+} hydrolysis and complexing into low-sorption forms. Further analysis indicated trilon-B, sodium citrate, and nitric acid are the best Ce^{144} desorbers. (R.V.J.)

27015 EFFECTS OF COMPLEXING COMPOUNDS ON Sr ION DISTRIBUTION BETWEEN ACTIVE MANGANESE DIOXIDE PRECIPITATE AND SOLUTION. Yu. V. Egorov and E. I. Krylov. Radiokhimiya, 4: 229-32(1962). (In Russian)

The distribution of microquantities of Sr^{89} between active manganese dioxide precipitate and aqueous solution was studied. It was found that the Sr^{89} distribution is a function of the active mass law. (R.V.J.)

27016 URANIUM EXCHANGE BETWEEN URANIUM(IV) AND URANYL OXALATE COMPLEXES. A. A. Grinberg and D. N. Bykhovskii. Radiokhimiya, 4: 234-8(1962). (In Russian)

Exchange between U(IV) and uranyl in oxalate media was established using U^{233} as a tracer. The exchange rate as a function of ion concentration is expressed by $R = k[U^{4+}]^{1.7}\ [UO_2^{2+}]^{0.5}$. It is postulated that the exchange between tetra- and penta-valent uranium determines the rate of exchange. (R.V.J.)

27017 ELECTRON PARAMAGNETIC RESONANCE AND SPIN-LATTICE RELAXATION OF Er^{3+} IN A CdF_2 SINGLE CRYSTAL. G. M. Zverev, L. S. Kornienko, A. N. Prokhorov, and A. I. Smirnov (Moscow State Univ.). Soviet Phys.-Solid State, 4: 284-6(Aug. 1962).

The electron spin resonance of Er^{3+} in CdF_2 was investigated at (9 to 72 kMc). It was found that $g = 6.758 \pm 0.010$ ($\nu = 9500$ Mc) and decreases as frequency increases; $A = (2.31 \pm 0.03) \cdot 10^{-2}$ cm^{-1}. The temperature dependence of spin-lattice relaxation was studied at 2 to 18°K. (auth)

27018 INFRARED INTENSITIES IN SiH_4 AND SiD_4. D. F. Ball and D. C. McKean (Univ. of Aberdeen, Old Aberdeen, Scotland). Spectrochim. Acta, 18: 1019-28(Aug. 1962).

Infrared absorption intensities have been measured for the bands due to ν_3 and ν_4 in SiH_4 and SiD_4 in the gas phase, high pressures of nitrogen being used to broaden the rotational fine structure. The plots of $\int \log I_0/I\ d \log \nu$ vs. partial pressure suggest that SiH_4 reacts with oxygen impurity in the nitrogen but that SiD_4 does not. The F sum rule for isotopic intensities is obeyed to within 2 per cent. Normal co-ordinates have been determined and used in conjunction with the observed intensities to calculate values of μ and $(\partial\mu/\partial r)$ for the SiH bond. Of the two alternative sets of values the following is the more probable: $\mu = \pm 1.58$ D, $(\partial\mu/\partial r) = \pm 1.23$ D/Å. The significance of this result is discussed. A value for the intensity of ν_2 in CO_2 is also reported. (auth)

27019 FREQUENCY SHIFTS FROM GAS TO CRYSTAL. I. SiH_4 AND SiD_4. D. F. Ball and D. C. McKean (Univ. of Aberdeen, Old Aberdeen, Scotland). Spectrochim. Acta, 18: 1029-37(Aug. 1962).

The existing theory of vibration frequency shifts in crystals is reviewed briefly. It is suggested that the total gas-crystal frequency shift $\Delta\nu_t$ may usefully be divided into two separate parts, $\Delta\nu_m$ the matrix shift and $\Delta\nu_c$ the coupling shift. The latter measures the part of the shift due to coupling between the vibrations of translationally equivalent molecules and is independent of correlation field splitting. Some considerable frequency shifts in SiH_4, SiD_4, and their mutual solid solutions have been measured. In these crystals the magnitudes of the coupling and matrix shifts are similar. The contributions to $\Delta\nu_m$ and $\Delta\nu_t$ from dipole-induced dipole and dipole-dipole forces are calculated using the Kirkwood-Bauer-Magat and Haas and Ketelaar equations. These predict shifts in the range 30 to 60 per cent of the observed ones. It is suggested that this proportion would be greatly increased in a more realistic treatment of the classical electrostatic forces. (auth)

27020 FLUORESCENCE SPECTRA OF URANYL PHOSPHATE AND OXALATE. K. V. Narasimham and V. Ramakrishna Rao (Andhra Univ., Waltair, India). Spectrochim. Acta, 18: 1055-8(Aug. 1962).

The fluorescence spectra of uranyl phosphate ($UO_2 \cdot HPO_4 \cdot H_2O \cdot 4H_2O$) and uranyl oxalate [$UO_2(COO)_2 \cdot 3H_2O$] have been studied with powder samples of the compounds at liquid-air and liquid-nitrogen temperatures for the first time. About thirty bands in the case of the phosphate and twenty-two bands in the case of the oxalate have been obtained. The fluorescence bands of each compound are analysed as due to a single allowed electronic transition. (auth)

27021 THE MECHANISM OF ION FIXATION USING RADIOISOTOPE TECHNIQUES. Donald G. Jacobs and Tsuneo Tamura (Oak Ridge National Lab., Tenn.). Trans. Intern. Congr. Soil Sci., 7th, Madison, Wisconsin, 1960, 2: 206-14(1960).

Cs sorption data obtained for a number of clay minerals indicate that Cs exchange is influenced markedly by the structure of the clay mineral. A collapsed c-spacing is necessary for Cs fixation, although the fixation process differs depending on whether the clay mineral lattice is originally collapsed or collapses during the fixation proc-

ess. In the case of originally collapsed lattices, the fixed cations are held with high affinity at exchange sites on the edge of the interlayer spacing, while lattices that collapse during the fixation process physically entrap the interlayer cations in a true fixation process. (auth)

27022 THE DIELECTRIC PROPERTIES OF HEAVY WATER IN DIOXANE. A. R. Tourky, H. A. Rizk, and Y. M. Girgis (National Research Centre, Cairo). Z. Physik. Chem. (Frankfurt), 32: 102-9(Apr. 1962). (In English)

The electric moment of heavy water in dioxane is 1.95 ± 0.01 D, and the dipole–dipole interaction energy, as calculated from polarization measurements, is 6.1 ± 0.3 ergs over the temperature range 30° to 50°. The molar decrement of the dielectric constant by the addition of dioxane is less for heavy water than that for water; the decrease becomes smaller in both cases with increasing dioxane concentration and temperature. In a mixture containing 81 mole % of heavy water the time of relaxation is double that of pure heavy water. The enthalpy of activation for dielectric relaxation in a mixture containing 50 mole % is nearly equal to that of heavy water in the pure state and seems to correspond to the rupture of one deuterium bond. In mixtures containing 35 to 81 mole % of heavy water, anomalous dispersion takes place at about −14.5° at a frequency of 1800 kc./sec. (auth)

27023 OXIDATION MECHANISM IN DIVALENT IRON OXIDATION BY MANGANESE DIOXIDE IN URANIUM HYDROMETALLURGY. G. M. Nesmeyanova and A. I. Vikulov. Zhur. Priklad. Khim., 35: 989-94(May 1962). (In Russian)

The mechanism of the catalytic oxidation of uranium following three consequent reactions: (1) $2Fe^{2+} + MnO_2 + 4H^+ \rightarrow Mn^{2+} + Fe^{3+} + 2H_2O$, (2) $UO_2 + 2Fe^{3+} \rightleftharpoons UO_2^{2+} + 2Fe^{2+}$, (3) $UO_2 + MnO_2 + 4H^+ \rightarrow UO^{2+} + Mn^{2+} + 2H_2O$ was studied. Effects of temperature (20 and 70°), time (15 to 30 min), and sulfuric acid concentration on the degree of iron oxidation by manganese dioxide were tabulated. (R.V.J.)

27024 THE BEHAVIOR OF FERROUS ELECTRODES IN MOLTEN CHLORIDES. V. N. Devyatkin and E. A. Ukshe (Branch of the All-Union Aluminum-Magnesium Inst., USSR). Zhur. Priklad. Khim., 35: 1328-33(June 1962). (In Russian)

Study of the behavior of nonequilibrium stationary electrodes in molten salts is useful for determining the principles of corrosion protection. The electromotive force of the $Mg/MgCl_2$, KCl, NaCl/Fe cell was determined at 720°C, keeping the Mg electrode surface constant while varying the Fe surface from 0.2 to 8 cm^2. The electrolyte contained $MgCl_2$ and equimolar mixture of KCl + NaCl in varying ratios. The data obtained indicated that the dissolved water, introduced by $MgCl_2$ and not by the Mg^{2+} ions, acted as the depolarizer of the corrosion reaction of Fe in the melt. The Fe ions, also present in the melt, were reduced at a potential of −0.35 v. Determination of the polarization curves of Fe in the chloride melt required extended exposure, as the polarization depends not only on the current density but also on the total amount of electricity passing through the system. Cathodic protection of Fe against corrosion by the melt appears to be feasible. (TTT)

27025 REVIEW OF INVESTIGATIONS IN THE FIELD OF THE ELECTROCHEMISTRY OF MOLTEN SALTS DURING 1961. A. G. Morachevskii. Zhur. Priklad. Khim., 35: 1390-1404(June 1962). (In Russian)

Continuing the previously published reviews of the molten salt (MS) literature (Zhur. Prikl. Khim., 33: 1434(1960); Ibid., 34: 1398(1961)), the subjects of the more recent publications are reviewed under the following headings: electrical conductivity and transfer numbers; electromotive force of galvanic cells with MS; galvanic cells with molten or solid electrodes; reference electrodes used in the electrochemical studies of MS; polarographic and diffusion investigations of MS; study of the electrical double layer in MS; physico-chemical properties of molten chlorides and fluorides; study of the metal-MS systems; current yields in the electrolysis of MS; investigation of the electrolytic preparation of Al, Mg and alkali metals; preparation of alloys by the electrolysis of MS using a liquid cathode; electrolysis with a liquid, soluble anode; electrolysis of MS under deposition of solid metals on the cathode; preparation of B and borides by the electrolysis of MS; preparation of alloys by the electrolysis of MS using a solid cathod; and electroplating by using molten electrolytes. (311 references). (TTT)

27026 ELECTRONOGRAPHIC STUDIES OF MOLECULAR STRUCTURE OF $LiBO_2$ AND $NaBO_2$ in VAPORS. P. A. Akishin and V. P. Spiridonov (Moscow State Univ.). Zhur. Strukt. Khim., 3: No. 3, 267-9(May-June 1962). (In Russian)

Electronographic studies were made of $LiBO_2$ and $NaBO_2$ in vapors, and geometric configurations and intranuclear distances of the molecules were found. (tr-auth)

27027 ELECTRONOGRAPHIC STUDIES OF MOLECULAR STRUCTURE OF $ZrCl_4$ AND $HfCl_4$ GASES. V. P. Spiridonov, P. A. Akishin, and V. I. Tsirel'nikov (Moscow State Univ.). Zhur. Strukt. Khim., 3: No. 3, 329-30(May-June 1962). (In Russian)

Molecular structures of $ZrCl_4$ and $HfCl_4$ vapors were studied in order to find a means for separating these closely-related metals. The analysis was made on $ZrCl_4$ and $HfCl_4$ that had been purified by sublimation in hydrogen and in vacuum. The electronographic studies revealed a tetrahedral structure with intranuclear distances of 2.32 ± 0.02 and 2.33 ± 0.02 Å for $ZrCl_4$ and $HfCl_4$, respectively. (R.V.J.)

27028 OPTICAL PROPERTIES OF RARE EARTH OXIDES. S. S. Batsanov, G. N. Grigor'eva, and N. P. Sokolova (Inst. of Inorganic Chemistry, Academy of Sciences, Siberian Branch of the Academy of Sciences, USSR). Zhur. Strukt. Khim., 3: No. 3, 339-42(May-June 1962). (In Russian)

The refraction indices and densities of rare-earth oxides were measured, and infrared spectra at 400 to 800 cm^{-1} were studied. (R.V.J.)

27029 SOLUTIONS AND METHODS FOR RADIOACTIVE DECONTAMINATION. Thomas J. Bulat (to Bendix Corp.). U. S. Patent 3,047,434. July 31, 1962.

A decontaminating solution is described which acts directly on the contaminant as well as removing the soil and which is sufficiently inexpensive for cleaning inexpensive hand tools. The solution contains a detergent, an ion exchange agent, an absorbent, and preferably a chelating agent and is used in conjunction with ultrasonic cavitation. A typical solution contains water, ethylenediamine tetraacetic acid, sodium sulfate, sodium hydroxide, manganese dioxide, and carbon black. (D.L.C.)

27030 RADIATION RESISTANT MINERAL OIL COMPOSITION. James Harold Thurston Brook and Roy William Glazebrook (to Shell Oil Co.). U. S. Patent 3,047,501. July 31, 1962.

Liquid hydrocarbon oils with high boiling points may be stabilized against radioinduced free radicals by addition of dihydroaromatic compounds. In the preferred composition, a dihydrophenanthrene derivative is added in

amounts of 4 to 15 wt %, and a chain transfer agent may also be added in amounts up to 2:1 relative to the dihydroaromatic. The chain transfer agent may be a mercaptan, alkyl phenol, thiophenol, alkylated aromatic amine, or highly halogenated hydrocarbon. The oil may also contain small amounts of other additives, e.g., antioxidants, corrosion inhibitors, etc. (D.L.C.)

27031 PREPARATION OF ANHYDROUS LITHIUM SALTS. Louis R. Grant and Moddie D. Taylor (to Callery Chemical Co.). U. S. Patent 3,049,406. Aug. 14, 1962.

A simple method is outlined for preparing anhydrous lithium halides and pseudohalides. The method comprises reacting LiH with a halogen or pseudohalogen (cyanogen or thiocyanogen) in ether solution. (D.L.C.)

Radiation Chemistry and Radiochemistry

27032 (CEA-2127) PREPARATION DU DIBENZO [a,c] ANTHRACENE ^{3}H-9-14. (Preparation of Dibenzo [a,c] Anthracene ^{3}H-9-14). Marcel Audinot and Louis Pichat (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). 1962. 7p.

The disodium addition product of dibenzo [a,c] anthracene is prepared by action of sodium powder in tetrahydrofuran as a solvent. Hydrolysis by tritiated water gives rise to 9-14 dihydro-dibenzo [a,c] anthracene-9-14 H^3 which is dehydrogenated into the required compound. Chemical yield based on dibenzo [a,c] anthracene is 89% and radioactive yield based on tritiated water is about 12%. (auth)

27033 (NP-11925) FLUORESCENCE EFFECTS IN ION EXCHANGE RESINS. T. R. Flint and G. G. Eichholz (Canada. Dept. of Mines and Technical Surveys. Mines Branch). Nov. 1961. 38p.

Available as Can. Dept. Mines and Tech. Surveys, Mines Branch Research Report R-91, $0.25.

Fluorescence under ultraviolet illumination was observed in anion and cation exchange resins when in the unloaded state. The fluorescence decreases rapidly in intensity as the resin is loaded and this process is shown to offer a practical method for controlling the loading and elution cycles in ion exchange operations. The relative effectiveness of different resins and various ions on the fluorescence quenching process was determined and some correlation was found between quenching efficiency and ionization potential of the elements. The measurements show adequate stability and reproducibility for industrial control applications. (auth)

27034 (NYO-9864) SYNTHESIS OF SEMICONDUCTOR MATERIALS BY RADIATION INDUCED REACTIONS. Final Report. Kalman M. Held and Richard J. Goldman (TRG, Inc., Syosset, N. Y.). [1961] Contract AT(30-1)-2392. 46p. (TRG-132-FR)

Activities in a program to prepare pure semiconductor materials by radiation-induced reactions are reported. The investigation is devoted primarily to silane. Included are data and a discussion concerning the preparation of silane and irradiation with Co^{60} gammas under several conditions. Results indicate that there may be several steps in the decomposition of silane which follow a heterogeneous mechanism. The G value for decomposition of silane was determined at several temperatures. Other compounds which might be of interest, these including Si_2H_6, GeH_4, and Ge_2H_6, were noted. (J.R.D.)

27035 (NYO-10200) A STUDY OF RADICAL-MOLECULE COMPLEXES AS INTERMEDIATES IN LOW TEMPERATURE RADIATION CHEMISTRY. Quarterly Report No. 1, April 1962–June 1962. (Little (Arthur D.) Inc., Cambridge, Mass.). June 25, 1962. Contract AT(30-1)-2977. 26p.

Studies of radical-molecule complexes as intermediates in radiation chemistry and the effect of low temperature on the stability of the complexes are reported. Equipment and techniques necessary to carry out the radiation study were developed and results are presented on a few initial experiments. Irradiations of propylene-carbon monoxide mixtures were carried out, both with and without added manganese carbonyl, at a few temperatures. The formation of a propylene carbon monoxide co-polymer is noted and discussed. Nitrosyl chloride was irradiated in both cyclohexane and 2,3-dimethylbutane. Product yields are low in terms of a radical-chain process. A protection effect on the cyclohexane system is noted. (auth)

27036 (RAI-307) A STUDY OF THE MECHANISM OF RADIATION-INDUCED GELATION IN MONOMER-POLYMER MIXTURES. Quarterly Summary Report, May 1–July 31, 1962. George Odian, Bruce S. Bernstein, Robert Connolly, Sidney Binder, and Dennis Beeferman (Radiation Applications Inc., Long Island City, N. Y.). Aug. 1, 1962. Contract AT(30-1)-2816. 29p.

The dose rate effect on polymer-monomer radiation crosslinking was studied over the 0.015 to 4.0 Mrad/hr range and gel content was found to be independent of the dose rate. This holds true for doses of 0.2 Mrads and above for Alathon 15 polyethylene equilibrium swollen at 25°C with allyl methacrylate prior to radiation. Tensile strengths of monomer crosslinked systems were also studied. Monomer-containing crosslinked systems, irradiated to very low doses, appear to be at least equal to straight radiation crosslinked polyethylene. Tensile strengths were obtained above the normal polymer T_m. The dose-gel relationship of the polyethylene-allyl acrylate system was elucidated up to 12 Mrads. The mole per cent of allyl acrylate present after equilibrium swelling is approximately equal to the mole per cent allyl methacrylate. The dose-gel relationship for polypropylene–allyl methacrylate was studied up to 63 Mrads. The gel content (with 5.5% monomer) increased rapidly at first, leveled off slowly, and remained essentially constant after about 9 Mrads. The gel content after 9 Mrads was 73% and after 63 Mrads was 75%. Monomer-crosslinked polypropylene were found to be superior to either untreated or straight irradiated polypropylene. Form stability was maintained after 18 hr at 235°C. Gel fractions were obtained after irradiating polyisobutylene containing various amounts of allyl methacrylate. The effect of radiation dose (up to 3.2 Mrads) on equilibrium swollen polymer specimens (35% allyl methacrylate) was also studied. (P.C.H.)

27037 (TID-16124) STUDIES IN NUCLEAR AND RADIOCHEMISTRY. [Progress] Report for the Period, May 1, 1961–April 30, 1962. Rolfe H. Herber (Rutgers Univ., New Brunswick, N. J.). Contract AT(30-1)-2472. 84p.

An investigation of Cl^{36} exchange between BCl_3 and HCl was resumed to clarify the second order HCl dependence suggested by earlier data; no conclusive data were obtained. In Mössbauer effect studies progress is reported in assembling a parabolic motion instrument. The instrument was not tested. Completed Mössbauer effect studies are reported on resonant gamma absorption of ferrocene, ferricinium bromide, and cobalticinium tetraphenyl borate. Mössbauer data are also included on 1,1′ (trimethylene) ferrocene, Iron(II) trifluoromethyl tetrazole, potassium

ferrate, iron pentacarbonyl and related compounds, Iron(III) acetyl acetonate and Co(III) (Co^{57}) acetyl acetonate, and cyclöoctatetraene iron carbonyl and related compounds. (J.R.D.)

27038 (WERL-0100) FORMATION OF CHEMICALLY FREE HALOGEN BY RADIOLYSIS OF SOLID POTASSIUM CHLORIDE. L. M. Epstein (Westinghouse Electric Corp. Research Labs., Pittsburgh). June 1962. Contract AT(30-1)-2829. 64p.

Radiation damage to potassium chloride by high energy electrons was investigated with reference to the use of the material as a secondary electron emitter on the dynode surfaces of image amplifier tubes. Samples of irradiated potassium chloride were dissolved in water and the yield of oxidizing agent measured chemically. Larger and more consistent yields were obtained from powders obtained by grinding than from single crystals or sublimed powders. The overall G value for powders decreased steadily with doses from 1.47×10^{-2} at 2×10^{7} rads to 5.1×10^{-4} at 3.27×10^{9} rads. Gamma and electron radiation gave essentially equivalent results. An upper limit of 0.5% of the total oxidizing substance formed (presumably chlorine) was condensable from the vapor phase following irradiation. An appreciable and unexpected increase in the yield of oxidizing substance with time following irradiation was observed and confirmed in several cases. Yields were sensibly unaffected by the presence of water vapor, but increased by the presence of oxygen during irradiation. Most added anions and cations had but a slight affect on the yield. Hydroxide ion caused a decrease in the apparent chlorine yield but not in the total oxidizing power measured with KI reagent. (auth)

27039 (AEC-tr-5152) THEORY OF MOLECULAR DISSOCIATION BY NEUTRONS: DIATOMIC MOLECULES. Yu. S. Sayasov and G. K. Ivanov. Translated from p.25-39 of "Proceedings of the Symposium on Chemical Effects of Nuclear Transformations, held in Prague, October 24-27, 1960. Vol. I" (a publication of the International Atomic Energy Agency, Vienna, 1961. (STI/PUB/34(Vol.I(p.25-39)). 19p.

A consistent theory was developed for the dissociation of diatomic molecules by neutrons from the Fermi pseudopotential method and the method of adiabatic approximation for molecular wave-functions. It is assumed that the energy E of the neutrons is of the order of the dissociation energy, $E < 10$ ev, and that the molecules disintegrate while remaining in the electronic ground state. It is shown that if the neutron energy is sufficiently greater than the threshold value, the dissociation energy D of the molecule, the cross section of the process does not depend on the exact value of the molecular potential but only on the frequency of vibration ω of the nuclei in the molecule. In the simplest case, which is the collision of a neutron with a heavy molecule containing hydrogen, the cross section of dissociation is determined by the neutron-proton interaction. Other cases are also considered. (P.C.H.)

27040 (CEA-tr-R-1503) ETAT DES MICROQUANTITES DE RADIOELEMENTS DANS DES SOLUTIONS. XI. MOBILITE ELECTROPHORETIQUE DU POLONIUM DANS LES SOLUTIONS AQUEUSES. (The State of Microquantities of Radioelements in Solutions. XI. Electrophoretic Motion of Polonium in Aqueous Solutions). I. E. Starik and N. I. Ampelogova. Translated into French from Radiokhimiya, 1: 414-18(1959). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 5146.

27041 (CEA-tr-R-1592) RÔLE DE LA RÉACTION DES ATOMES D'HYDROGÈNE AU COURS DE LA RADIOLYSE. (The Importance of Hydrogen Atom Reactions in Radiolysis). Yu. N. Molin. Translated into French from Kinetika i Kataliz, 2: 490-1(1961). 4p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 11729.

27042 (CEA-tr-R-1597) LE PROBLÈME DE L'ÉTAT MOLÉCULAIRE DES MICROQUANTITÉS DE RADIOÉLÉMENTS EN SOLUTION. (On the Molecular State of Microquantities of Radioelements in Solution). I. E. Starik, N. I. Ampelogova, F. L. Ginzburg (Guinsburg), M. S. Lambet, I. A. Skul'skii (Skulsky), and V. N. Shchebetkovskii (Shchebetovsky). Translated into French from Radiokhimiya, 1: 370-8(1959). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 5243.

27043 (CEA-tr-X-444) DE LA PRÉPARATION DU CUIVRE-64, DU NICKEL-65 ET DU MANAGNÈSE-56 À HAUTE ACTIVITÉ SPÉCIFIQUE. (On the Preparation of Copper-64, Nickel-65, and Manganese-56 of High Specific Activities). Hiroshi Ebihara and Kenji Yoshihara. Translated into French from Bunseki Kagaku, 9: 815-21(Oct. 1960). 21p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 10997.

27044 (CEA-tr-X-462) UTILISATION DES RÉACTEURS DE RECHERCHE EN CHIMIE. (Utilization of Research Reactors in Chemistry). A. H. W. Aten, Jr. Translated into French from Chem. Weekblad, 54: 642-4 (1958). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 8310.

27045 (FTD-TT-62-838) THE FORMATION OF HYDRAZINE BY THE ACTION OF γ-RADIATION ON SOLID AND LIQUID AMMONIA. Yu. A. Sorokin and S. Ya. Pshezhetskii (Pshezhetskiy). Translated from Doklady Akad. Nauk S.S.S.R., 138: 880-3(June 1, 1961). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 26081.

27046 (SCL-T-429) INTRAMOLECULAR MIGRATION OF ENERGY DURING THE RADIOLYSIS OF ALKYLBENZENES. Kh. S. Bagdasar'yan, N. S. Izrailevich, and V. A. Krongauz. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Doklady Akad. Nauk S.S.S.R., 141: 887-90(1961). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 8767.

27047 SEPARATION OF FAST NEUTRON AND γ RAY EFFECTS IN WATER RADIOLYSIS. P. Bebeshel and I. Purika. Acad. rép. populaire Roumaine, Rev. phys., 6: 273-8 (1961). (In Rumanian)

The rate of water radiolysis in vertical reactor channels and its reaction to power variations (variations in fast neutron and γ flux) are determined. The total gas volume produced by fast neutrons and γ rays was calculated, and the radiochemical yields for gamma (G_γ) and fast neutron (G_n) radiolysis were determined. (R.V.J.)

27048 ERP INVESTIGATION OF THE ACTION OF A RADIO-PROTECTIVE MATERIAL IN A MODEL SYSTEM. E. Schroeder and H. G. Thom (Inst. for Medicine and Biology, Berlin). Arch. sci. (Geneva), 14: 197-200(Sept. 1961). (In German)

Radioprotective substances (e.g., AET, cysteine, and ascorbic acid) are dissolved in appropriate solvents and mixed in a 1:1 mole ratio with DPPH. These solutions are then added to acrylic acid or methyl methacrylic acid, and their protective effects on the radiation polymerization of

these acids are studied. Doses up to 10^5 or 10^6 r are considered. The polymerization reaction is followed by EPR spectral measurements. The results agree less with an hypothesis of a direct radical-neutralizing mechanism than with a more complex mechanism in which the radiation energy is given paths around the biological material by the radioprotective substances. (T.F.H.)

27049 THE DEPENDENCE OF THE EPR SPECTRA OF FREE RADICALS IN POLYMETHYLMETHACRYLATE ON THE RADIATION DOSE. Rudolf Lenk (Institut fur Kernforschung, Rez, Prague). Arch. sci. (Geneva), 14: 201-3(Sept. 1961). (In German)

The variation of the hyperfine structure of EPR spectra of free-radical species in polymethylmethacrylate as a function of gamma radiation dose was investigated. A decrease of subsidiary peaks of the hyperfine structure of free-radical EPR spectra after a total radiation dose above $3 \cdot 10^4$ was found. The radiation dose rate used was $1.17 \cdot 10^5$ r/hr. The dose $3 \cdot 10^6$ r was about the dose at which the equilibrium between formation and recombination of free radicals set in. All irradiation and measurements were made at room temperature. The observed effect was also found in other irradiated polymers. (auth)

27050 ELECTRON PARAMAGNETIC RESONANCE IN X-IRRADIATED SOLID SACCHAROSE. G. Lomaglio (Universite Besancon, France). Arch. sci. (Geneva), 14: 204-5(Sept. 1961). (In French)

Polycrystalline samples are irradiated with 6 ma of 40-kv x rays for periods up to 18 hr. The EPR spectra observed are found to be composed of two triplets, almost symmetrical with respect to their common center. The general features of the electron paramagnetic interactions in the solid are inferred from the properties of the EPR spectra observed. (T.F.H.)

27051 NUCLEAR RELAXATION IN SOLID IRRADIATED CYCLOHEXANE. C. Brot (Lab. of Chemical Physics, Orsay, France). Arch. sci. (Geneva), 14: 383-5(Sept. 1961). (In French)

The spin-lattice relaxation time (T_1) of protons in γ-irradiated solid cyclohexane is studied at 77°K. For sufficient dose, T_1 is shown to be inversely proportional to the dose. (auth)

27052 DYNAMIC POLARIZATION OF PROTONS AND FLUORINE NUCLEI. J. Burget, M. Odehnal, V. Petříček, and J. Šácha (Inst. of Nuclear Physics, Czechoslovia Academy of Science, Prague). Arch. sci. (Geneva), 14: 487-9 (Sept. 1961). (In German)

Protons in neutron-irradiated polyethylene, polycarbonate, silicon, polystyrene, buna, and fluorine nuclei in teflon, were polarized by the "solid effect" method. The maximum enhancement of polarization in polyethylene and polycarbonate was 15, and in other polymers 7 to 10. The dependences of polarization on microwave power incident on the cavity and on nuclear magnetic resonance frequency were studied. (auth)

27053 USE OF BASIC SILICA GEL FOR THE SEPARATION OF THE RADIOELEMENTS. Giuseppe Cetini, Olimpia Gambino, and Franco Ricca. Atti accad. sci. Torino. I. Classe sci. fis., mat. e nat., 95: 833-42(1960-61). (In Spanish)

The element pairs in radioactive equilibrium, Sr^{90}-Y^{90} and Cs^{137}-Ba^{137}, were separated on basic silica gel using inorganic eluants. The same technique was used to separate radioisotopes of K, Rb, and Cs from a mixture of their salts in aqueous solution. (tr-auth)

27054 A STATISTICAL THEORY OF HOT ATOM CHEMISTRY. [PART] I. P. Frere (Centre d'Étude de l'Énergie Nucléaire, Mol, Belg.). Bull. classe sci., Acad. roy. Belg., (5) 48: 216-24(1962). (In English)

The chemical effects which result from the passage of energetic atoms through liquid or gaseous media were studied by means of exact methods of the theory of probability. The distribution function for the number of hot products were determined in terms of the efficiency of reaction upon collision. (auth)

27055 NOVEL DEVIATIONS FROM THE 'MIXTURE LAW' IN THE RADIOLYSIS OF HYDROCARBON MIXTURES. P. J. Dyne and J. Denhartog (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem., 40: 1616-25(Aug. 1962). (AECL-1543)

The "mixture law" states that, if the radiolysis of material A gives a product M with yield G_M, then, in a mixture where the mole fraction of A is X_A, the yield of M is $G_M X_A$. In the radiolysis of dilute mixtures of cyclohexane-$\underline{d}_{12}$ or of methylcyclohexane-$\underline{d}_{14}$ with other aliphatic hydrocarbons, D_2 is formed in a process which is first order with respect to the deutero compound. As a consequence these mixtures provide a sensitive method of detecting deviations from the mixture law. Experimentally the yield of D_2 and the yield of HD vary widely from one solvent to another among the C_5 to C_{10} hydrocarbons selected. The yields of D_2 and HD are, approximately, linearly related. The solvents have similar quantitative effects on the yields for both deuterated hydrocarbons. These deviations from the mixture law cannot be explained in terms of kinetic effects (variations in rate constants caused by differing bond strengths), because the D_2 yield measures a process without free radical intermediates. Mechanisms involving excitation transfer, ion-molecule reactions, and subexcitation electrons are discussed. (auth)

27056 INFLUENCE OF THE DEFECT CENTERS ON THE SZILARD-CHALMERS ANNEALING. Irina Negoescu and T. Costea (Inst. of Atomic Physics, Bucharest). Can. J. Chem., 40: 1642-8(Aug. 1962).

Reactor-irradiated copper and cobalt oxinates were studied for the behavior of Cu^{64} and Co^{60} atoms produced by radiative thermal neutron capture. The annealing processes associated with the Szilard–Chalmers effect were followed by means of retention. Both substances exhibit annealing at room temperature, formally following first-order kinetics. The retention was found to increase with reactor exposure time, following kinetics similar to that for post-irradiation thermal annealing. The interpretation of experimental data relies on the assumption that fractions annealed at room temperatures decrease with increasing density of defect centers containing an annealable Szilard–Chalmers atom. (auth)

27057 SORPTION OF RADIOACTIVE ISOTOPES ON PRECIPITATES. VI. THE SYSTEM IRON(III) HYDROXIDE-STRONTIUM NITRATE SOLUTION AND THE GENERAL REGULARITY OF THE SORPTION OF IRON(III) HYDROXIDE. Z. Kolařík (Tschechoslowakische Akademie der Wissenschaften, Prague). Collection Czechoslov. Chem. Communs., 27: 938-50(Apr. 1962). (In German)

The mutual exchange of Sr and H ions on ferric hydroxides was followed radiometrically as a function of the total concentration of the Sr ions, of the ferric hydroxide concentration, and of the pH value of the supernatant solution. The sorption of Sr ions by ferric hydroxide can be considered as

a special case of complex formation. With the help of this conception equations were derived, through the application of the mass effect law, which make possible a determination of the pattern of the sorption reactions and, in simple cases, their equilibrium constants. (tr-auth)

27058 SORPTION OF RADIOACTIVE ISOTOPES ON PRECIPITATES. VII. SORPTION OF STRONTIUM IN MANGANESE(IV) HYDROXIDE. Z. Kolarik (Tschechoslowakische Akademie der Wissenschaften, Prague). Collection Czechoslov. Chem. Communs., 27: 951-9(Apr. 1962). (In German)

The mutual exchange of Sr and H ions and precipitates of manganic hydroxide was investigated radiometrically. The effects of the contact time of the precipitate with the solution, of the H and Na ion concentrations, and the concentration of the sorbent were followed. The mechanism of the sorption reaction was clarified with the help of the mass effect laws. (tr-auth)

27059 SORPTION OF RADIOACTIVE ISOTOPES ON PRECIPITATIONS. VIII. SORPTION OF TRACE AMOUNTS OF YTTRIUM AND CERIUM ON MANGANESE(IV) HYDROXIDE. Z. Kolařík (Inst. for Nuclear Research, Czechoslovak Academy of Science, Rez). Collection Czechoslov. Chem. Communs., 27: 1333-7(May 1962). (In German)

The results obtained in the study of the sorption of trace amounts of yttrium and cerium on manganese hydroxide were compared. The effect of the hydrogen ion concentration and the concentration of the adsorbent was measured and the optimum conditions for the adsorption and desorption were determined. The composition of the complexes formed was established, and the value of the formation constants was determined. (J.S.R.)

27060 THE RADIATION CHEMISTRY OF STYRENE AND POLYSTYRENE. Jerome Goodman (Brooklyn Polytechnic Inst.). Dissertation Abstr., 22: 1025(Oct. 1961).

Polystyrene labeled with tritium, mostly on the alpha carbon, was irradiated in vacuum with x rays. The volatile radioactive products were counted and analyzed by gas-chromatographic techniques. G values (molecules formed per hundred electron volts absorbed) were obtained for tritiated products, based on energy absorbed only by the labeled monomer units in the polystyrene. These G values would apply to a polystyrene in which each styrene unit had a tritium atom in it. The G's were: G(T), .00047; G(CH_3T), .00018; G for a fraction volatile at dry ice temperature but not at liquid nitrogen temperature (DIV fraction), .00095; G for a fraction volatile at room temperature but not at dry ice temperature (DINV fraction), .0061. From the extrapolation of values of deuterium isotope effects, tritium isotope effect values were estimated. G(H)'s of .0022 and .0046 for the alpha hydrogen were thus obtained, and corresponded to G(H)'s of .010 and .020 for the overall yield. These values may be compared with published values of .045 and .078. By assuming mechanisms for the formation of the other products, it was possible to calculate G's for the products from an unlabeled polystyrene. These G's were: G(CH_4), .00036; G(DIV fraction), .00095 to .21, depending on the mode of formation; and G(DINV fraction), .0061 if none of the product remained in the polystyrene. If only one to ten percent of the DINV products were actually collected, the true G(DINV) would be .061 to .61. The minimum G values obtained for the components of the DINV fraction (based on complete removal from the polymer) were: G(benzene), .0052; G(toluene), .00022; G(ethylbenzene and xylene), .00018; and G(styrene), .00061. The benzene might arise from exchange with solvent benzene trapped in the polymer during purification. Products from the gamma irradiation of an unlabeled polystyrene (dose 10^8 roentgens) were determined by mass spectrometry and included hydrogen with a G of .041. The detection of a dimer of styrene (G(dimer collected) = .00002) suggested that a significant amount of monomer was formed in polystyrene irradiation. In dosimetric studies, the products formed in the irradiation of water saturated with benzene were investigated. The phenol produced was found to be accompanied by a material resembling it. It was shown that a benzene-water dosimeter could be based on the absorbance of the 345 mμ peak associated with the phenol-like material. Finally, the radiation-induced polymerization of styrene was studied viscometrically and by dilatometry. The polymerization of styrene exposed to x rays or gamma rays was found to be markedly reduced in the presence of small concentrations of scintillators. Anthracene, p-terphenyl, and diphenylhexatriene were used and had similar effects. Anthracene at a concentration of about one gram per liter reduced the radical yield in styrene by about half. It was demonstrated that the scintillators did not cause any appreciable reduction in thermal polymerization rates. Therefore the observed effects were not due to simple scavenging of styrene radicals. The results suggested that in an irradiated solution containing scintillator, styrene, and benzene, the styrene would be protected by the scintillator and could at the same time be sensitized by energy transfer from benzene to scintillator to styrene.

27061 CHLORINE HYPERFINE INTERACTION IN FREE RADICAL ELECTRON SPIN RESONANCE — IRRADIATED SINGLE CRYSTALS OF CHLOROACETAMIDE AND CHLOROACETIC ACID. Roger Patrick Kohin (Univ. of Maryland, College Park). Dissertation Abstr., 22: 3233-4 (Mar. 1962).

X-irradiated single crystals of chloroacetamide and chloroacetic acid were investigated using electron spin resonance spectroscopy. The resonances obtained showed complex angular-dependent hyperfine patterns in which the transition probabilities of the individual component lines were strongly angle-dependent. The spectra were interpreted as arising from the $\cdot CHClCONH_2$ and $\cdot CHClCOOH$ radicals. These radicals were found to be π-electron radicals in which the unpaired π-electron was located predominately at the β-carbon. Anisotropic hyperfine interactions between the electron and both the hydrogen and chlorine nuclei were observed. The hydrogen hyperfine interaction was found to be characteristic of that arising from a single σ-proton interaction. The measured values of the principal hyperfine tensor components were found to agree with those obtained in malonic acid. The magnitude of the largest chlorine hyperfine tensor component was 55 Mc and was observed when the magnetic field was perpendicular to the plane formed by the CHCl group in chloroacetamide. The hyperfine tensor components in the CHCl plane were smaller. The magnitude obtained when the magnetic field was parallel to the carbon-chlorine bond was 17 Mc and in the third direction it was less than 10 Mc. The relative signs were not determined. It was found necessary to include the effect of the chlorine nuclear quadrupole interaction in a description of the chlorine hyperfine coupling. The nuclear quadrupole splittings in the undamaged molecules were 35 Mc, of the same order of magnitude as the observed hyperfine splittings. For this case no component of nuclear spin could be conserved and the eigenfunctions of the spin Hamiltonian contained mixtures of states corresponding to all values of I_z. Thus the selection rule for electron spin resonance transitions ($\Delta m_I = 0$) no longer applied. The spin

Hamiltonian, including an axially symmetric quadrupole interaction in the direction of the carbon-chlorine bond, was diagonalized using numerical methods. This calculation showed that the forbidden transitions were for some orientations of the external magnetic field much stronger than the allowed transitions. The angular dependence of the hyperfine spacings and the transition probabilities predicted were found to agree qualitatively with the observed spectra. Quantitative agreement was not exact. The magnitude of the chlorine hyperfine interaction could be explained by assuming an electronic wave function in which the carbon-chlorine bond had approximately 12% double-bond character. In this structure, the unpaired electron was located in a chlorine $3p_x$ orbital perpendicular to the CHCl plane. This resulted from the unpairing of the other $3p_x$ chlorine electron to form the π-bond. The contribution to the hyperfine interaction from the amino hydrogens in chloroacetamide was small, having a maximum value of 13 Mc. The nitrogen hyperfine interaction caused line broadening when the magnetic field was perpendicular to the molecular field but was not resolvable. No broadening was observed in perpendicular orientations.

27062 THE THEORY OF DEFECTS FORMED IN A SOLID BY RECOIL ATOMS DURING GAMMA EMISSION. B. N. Finkel'shtein and Yu. L. Khait (Moscow Steel Inst. and United Textile and Light Industry Inst., USSR). Doklady Akad. Nauk S.S.S.R., 144: 85-8(May 1, 1962). (In Russian)

Two γ rays are emitted by a nucleus: one having a natural width Γ_1 and an energy equal to the transition energy ϵ, and one having a width $\Gamma_2 \approx \epsilon v/c$ and an energy shifted with respect to ϵ by an amount $W = \epsilon^2/Mc^2$, which is equal to the recoil energy of an emitter of mass M. Here v is the average thermal velocity of the emitting nucleus, and c is the velocity of light. The recoil atom may carry considerable energy, and can cause lattice defects in a small localized volume Q of the lattice. The number of defects in the volume Q becomes quasistationary, only when the energy density is lowered to a value satisfying the condition: $(W/n) \approx (Wd^3/Q\beta) < E_{min}$. Here W is the energy dissipation; n is the number of degrees of freedom in a volume Q, and β is the number of degrees of freedom in a volume d^3 (d is the distance between atoms). Subsequent dissipation of energy is by way of heat conduction. The mean free path for the high-density energy region is $l \approx Q^{0.33} \approx d(\epsilon^3/\beta Mc^2 E_{min})^{0.33}$. At $\epsilon = 4 \times 10^6$ ev, $M = 5 \times 10^{-22}$ grams, $\beta = 3$, $E_{min} = 0.5$ ev and $d = 3 \times 10^{-8}$ cm, it is found that $n > 1200$, $Q > 400\ d^3 \approx 10^{-20}$ cm^3, and $l > 10^{-7}$ cm. Hence, since the volume Q contains a large number of degrees of freedom, local values of the entropies S before and after the emission of the gamma quantum can be introduced to obtain the probability for the formation of a defect with a threshold energy E in a volume Q within a time τ. The probability for the formation of defects by recoil atoms depends only slightly on the temperature of the crystal. (TTT)

27063 THE MECHANISM BEHIND THE PROTECTIVE ACTION OF AN AROMATIC AMINE DURING RADIOLYSIS OF A POLYMER. THE FORMATION OF AN AMINE ION-RADICAL BY ACTIVATION. Kh. S. Bagdasar'yan, V. A. Krongauz, and N. S. Kardash (L. Ya. Karpov Physical Chemistry Inst., USSR). Doklady Akad. Nauk S.S.S.R., 144: 101-4(May 1, 1962). (In Russian)

Two samples of polymethylmetacrylate, one (I) prepared by polymerization of the monomer (mol. wt. $\sim 7 \times 10^6$) and the other (II) by thermal polymerization in the presence of dinitryl azoisobutyric acid at 60°C (mol. wt. $\sim 10^6$), were dissolved in a methylene chloride solution containing β-naphthylamine, phenyl-β-naphthylamine, diphenylamine or triphenylamine as an anti-radical agent. Films 100 μ thick were prepared and irradiated with Co^{60} γ rays at room temperature or at liquid-nitrogen temperature. The number of bonds broken in the polymer was calculated from the average molecular weight of the polymer before and after irradiation, and the molecular weight was determined from the viscosity from the formula: $[\eta] = 4.8 \times 10^{-5}\ (1.90\ M)^{0.80}$. The concentration of amine in the film before and after irradiation was determined by dissolving the film in chloroform and measuring spectrophotometrically at 520 mμ the amount of dye formed by diazotizing the amine with n-nitrobenzoyldiazonium compound in alcoholic solution. Irradiation of a pure polymer at room temperature gave a G yield for broken bonds of 1.7. In the presence of an amine as an anti-radical agent, the G yield for broken bonds decreases with increasing concentration of amine, and is 0.65 at a concentration of phenyl-β-naphthylamine of 0.2 mols/liter. At −196°C the G yield for broken bonds tends to a limiting value of 0.8 for the pure polymer, and to 0.4 for the polymer containing 0.05 mol/l of triphenylamine. The formation of colored films (pink for β-naphthylamine, green for phenyl-β-naphthylamine and blue for diphenylamine and triphenylamine) was observed at −196°C due to the presence of an ion-radical such as $(C_6H_5)_3N^+$. The color rapidly disappeared on heating the film to room temperature. At a dose of 1×10^{20} ev/g the concentration of amine radicals is 1×10^{-3} mol/l, and the G yield of $(C_6H_5)_3N^+$ is 0.8 (per 100 ev of energy absorbed by the entire system). This high radiation yield cannot be explained by the direct effect of radiation on the amine, but is due to secondary, energy transfer processes. (TTT)

27064 THE ELECTRIC AND PARAMAGNETIC PROPERTIES OF POLYETHYLENE SAMPLES SUBJECTED TO IRRADIATION AND THERMAL TREATMENT. N. A. Bakh, V. D. Bityukov, A. V. Vannikov, and A. D. Grishina (Inst. of Electrochemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 135-8(May 1, 1962). (In Russian)

The occurrence of semiconductor properties in high-density polyethylene was followed by irradiating samples in a reactor at ~ 60°C to an adsorbed dose of ~ 10^{24} ev/g. Thermal pyrolysis in vacuum up to 1000°C can be performed on the irradiated samples with a 50% yield, if the irradiation is carried out in the presence of oxygen or if the sample is subjected to a brief preliminary thermal preoxidation. The conductivity σ increased monotonically from $\sigma \sim 10^{-16}$ ohm^{-1}-cm^{-1} for a nonpyrolized, irradiated polyethylene sample to $\sigma \sim 10^{-1}$ ohm^{-1}-cm^{-1} for an irradiated polyethylene sample heated to 800°C in vacuum after irradiation. An increase in absorbed dose from 2×10^{22} to 1.5×10^{24} ev/g led to an increase in conductivity. The thermal emf dropped from 250 to 4 μV/degree, as the thermal treatment temperature was increased from 620 to 930°C. The presence of oxygen in the irradiated polyethylene sample increased the conductivity and thermal emf of the sample. The results of electron paramagnetic studies showed that molecular oxygen has the following effects on the EP spectrum: line broadening occurs without a change in the number of paramagnetic centers, the g-factors of various domains in the polyethylene sample are affected by the presence of oxygen, oxygen promotes exchange, and the paramagnetic centers are blocked for a thermal treatment of > 600°C in vacuum. Further study is required to relate these effects to the electrical effects observed in irradiated polyethylene which was subsequently subjected to thermal treatment in vacuum. (TTT)

27065 THE PREPARATION AND PROPERTIES OF THE NITRATE COMPLEXES OF QUADRIVALENT URANIUM. A. D. Gel'man, N. N. Krot, and N. P. Ermolaev (Inst. of Physical Chemistry, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 144: 562-4(May 21, 1962). (In Russian)

The stability of the nitrate complexes of U(IV) was found to increase with increasing ionic strength of the solution. Small amounts of aromic amines were added to stabilize the uranium(IV) state. The maximum difference in molar extinction coefficients is observed at λ = 648 mu. The stability constants of the nitrate complexes were determined from the changes in light absorption of U(IV) on a sulfonic cation exchanger in the hydrogen form as a function of the concentration of nitric acid. At an ionic strength of 2.0, the instability constants are 1.58 for $U(NO_3)^{3+}$, 1.48 for $U(NO_3)^{3+}$, 1.48 for $U(NO_3)_2^{2+}$, 0.96 for $U(NO_3)_3^{+}$, and 0.35 for $U(NO_3)_4$. At an ionic strength of 3.5, the instability constants are 2.29, 2.95, and 1.51 respectively. In solutions containing > 3N HNO_3, uranium(IV) forms negatively charged complexes such as $[U(NO_3)_6]^{2-}$. Complex nitrates containing the cations, cesium, rubidium, potassium, zinc, magnesium, pyridine, α-aminopyridine, quinoline, and α,α-dipyridine were prepared by adding 4 to 10 volumes of concentrated nitric acid, saturated with the cation in question, to a 2 to 3 M UCl_4 solution with cooling. The U(IV) nitrate complexes are readily soluble in water and dilute HNO_3, but the solubility decreases with increasing HNO_3 concentration. The Cs_2 $U(NO_3)_6$ and Rb_2 $U(NO_3)_6$ compounds are the least soluble. The U(IV) hexanitrates containing quinoline, α-aminopyridine, α,α-dipyridine, cesium, or rubidium as the cation are less than 10% oxidized on storage at room temperature for three months. The Zn $U(NO_3)_6 \cdot 8H_2O$ and $(C_6H_5NH)_2$ $U(NO_3)_6$ compounds are 50% decomposed in one to two weeks. (TTT)

27066 THE RADIATION CHEMISTRY OF AQUEOUS SALT SOLUTIONS OF DIVALENT PALLADIUM. Vikt. I. Spitsyn, A. A. Balandin, L. I. Barsova, and A. K. Pikaev (Moscow Univ., USSR). Doklady Akad. Nauk S.S.S.R., 144: 588-91(May 21, 1962). (In Russian)

Air-saturated solutions of palladium chloride (0.001 to 0.1M), potassium tetrachloropalladate (0.01 to 0.001M) and palladium sulfate (0.03M) were irradiated with 0.8 Mev electrons. Chemical and x-ray analyses proved that the black precipitate that formed on irradiation was palladium black. The reduction of the salt to the metal was complete, if the absorbed dose was sufficiently high. Irradiation of palladium nitrate solutions (0.01 to 0.001M) led to formation of the hydroxide. The radiation yield of the reduction of divalent palladium G ($-Pd^{2+}$) was determined by measuring the optical density of the solution as a function of the time of irradiation and by weighing the precipitated metal. The radiation yields G (Pd) and G ($-Pd^{2+}$) increased with decreasing strength of the absorbed dose, because of reduction of Pd^{2+} by atomic hydrogen and hydrogen peroxide which originate from the radiolysis of water. The addition of palladium black (0.0018 gram of metal per 8 ml of solution), which catalyzes the decomposition of hydrogen peroxide, led to incomplete reduction of Pd^{2+} to the metal. In a 0.1M solution of $PdCl_2$, the reduction of Pd^{2+} to metal was incomplete due to oxidation of Pd metal by hydroxyl radicals or by chlorine radicals. Palladium hydroxide was formed on irradiating a palladium nitrate solution due to the increase in the pH of the solution as a result of irradiation. (TTT)

27067 THE EFFECTS OF TEMPERATURE AND VARIOUS SOLUTES ON THE RADIOLYSIS OF CCl_4. Fred P. Abramson, Brenda M. Muckhold, and Richard F. Firestone (Western Reserve Univ., Cleveland). J. Am. Chem. Soc., 84: 2285-8(June 20, 1962).

Some effects of temperature and of various solutes (Cl_2, Br_2, I_2, O_2 and C_2Cl_4) on the Co^{60} gamma-ray-induced decomposition of liquid CCl_4 were investigated. Cl_2 and C_2Cl_6 were the only detectable products in pure, air-free, dry CCl_4. O_2 accelerated and C_2Cl_4 inhibited the decomposition. Scavenger studies indicated that an abundance of CCl_3 radicals were formed, most of which back-reacted to form CCl_4 at measurable Cl_2 concentrations. No other radicals were detected. A rapid initial reaction with a temperature coefficient of about 3%/°C was observed above room temperature. This reaction was strongly inhibited by Cl_2 to a terminal rate which was independent of temperature. A diffusion-limited free-radical mechanism involving thermal CCl_3-radicals and excited CCl_3-radicals is proposed to rationalize the effects of temperature and Cl_2. (auth)

27068 COMPETITIVE REACTIONS OF RECOIL TRITIUM ATOMS IN LIQUID MIXTURES. Alicja Sokolowska, Larry A. Haskin, and F. S. Rowland (Univ. of Kansas, Lawrence). J. Am. Chem. Soc., 84: 2469-74(July 5, 1962).

The chemical reactions of recoil tritium atoms from $Li^6(n,\alpha)H^3$ were studied in mixtures of solvents containing low concentrations of LiBr. The ratio of the specific radioactivities of aromatic and aliphatic components varies as much as a factor of 4 as the volume fractions of each are varied from 0.025 to 0.0975. This variation is caused almost entirely by an increase in the specific tritium radioactivity of the aromatic ring at low mole fractions of the aromatic component and was observed both for aniline and benzoic acid in mixtures with ethanol and acetone. The experimental observations are consistent with a model for competitive recoil tritium reactions that assumes the energetic reactions occur with single molecules, independent of neighbors, and in proportion to the concentration of each molecular species. The relative probabilities of T for H substitution vary with the energy of the tritium, but the fraction of bond-forming interactions and the energy degradation spectrum in non-bonding interactions are generally similar for all molecules in the higher kinetic energies. (auth)

27069 THE PREDOMINANT REACTION OF SOME FLUORINATED POLYMERS TO IONIZING RADIATION. Robert Timmerman (Radiation Dynamics, Inc., Westbury, N. Y.) and William Greyson. J. Appl. Polymer Sci., 6: 456-60(July-Aug. 1962).

Polytetrafluoroethylene was irradiated in air, in a vacuum, at elevated temperature, in a nitrogen atmosphere, and in some combinations of these conditions. In all cases the plastic was found to degrade in its structural characteristics. Even the most favorable condition of irradiation (irradiation in vacuo) resulted in a 44% reduction of tensile strength at a dose of 2 Mrad. Polyvinylidene fluoride resisted radiation to at least 100 Mrad effectively. Polyvinyl fluoride was structurally degraded at this dose but retained its structural properties to at least 32 Mrad. A cut-through test under heat compared polytetrafluoroethylene with polyvinylidene fluoride and polyvinyl fluoride. Unirradiated polytetrafluoroethylene was most resistant to heat aging. Irradiated and unirradiated polyvinylidene fluoride was inferior to irradiated polytetrafluoroethylene in heat resistance. Irradiated polyvinyl fluoride was superior to irradiated polytetrafluoroethylene; polytetrafluoroethylene at 2 Mrad was inferior to polyvinyl fluoride at 32 Mrad in cut-through testing. Polyvinylidene fluoride irradiated and unirradiated and polyvinyl fluoride and irradiated polytetrafluoroethylene all embrittled during heat testing. (auth)

27070 EFFECT OF RADIATION OF POLYETHYLENE ON ENVIRONMENTAL STRESS CRACKING. Gerald Liebling, Stephen Barton, and Robert Ullman (Polytechnic Inst. of Brooklyn). J. Appl. Polymer Sci., 6: 461-4(July-Aug. 1962).

The influence of radiation on the environmental stress cracking of polyethylene is described. The polymer was irradiated by Co^{60} γ rays, and studied as a function of a variety of experimental conditions. The deleterious effects of oxygen were noted. To prevent oxidative deterioration, the free radicals created had to be terminated by a heat treatment in the absence of oxygen. Some procedures were developed in which polyethylene could be made resistant to environmental stress cracking. (auth)

27071 RADIOLYSIS OF LIQUID CYCLOHEXANE IN THE PRESENCE OF NITRIC OXIDE. Jeannine Milhaud and Jean Durup (Faculté des Sciences, Orsay, France). J. chim. phys., 59: 309-14(Apr. 1962). (In French)

The consumption rate of NO during the γ irradiation of cyclohexane in the presence of NO was measured. It was established that the products formed lead, by a secondary excitation, to a sharp acceleration of the NO consumption. (tr-auth)

27072 RADIOLYSIS OF LIQUID CUMENE IN THE PRESENCE OF NITRIC OXIDE. Jeannine Milhaud and Jean Durup (Faculté des Sciences, Orsay, France). J. chim. phys., 59: 315-16(Apr. 1962). (In French)

The high consumption rate of NO, measured during the γ irradiation of cumene in the presence of this gas, should be attributed to a long chain reaction in which each link brings about the consumption of two molecules of NO and the formation of one nitrogen molecule. (tr-auth)

27073 RADIOCHEMICAL POLYMERIZATION OF STYRENE IN AQUEOUS SUSPENSION. Naruo Maeda (Kanegafuchi Chemical Industry Ltd., Osaka). J. chim. phys., 59: 336-41(Apr. 1962). (In French)

The radiochemical polymerization of styrene in aqueous suspension was studied by the utilization of polyvinyl alcohol (PVA) as dispersion agent. It was found that, for a given intensity of γ radiation, the conversion speed and the grafting yield of the styrene increased slightly with the concentration of PVA in the solution. The proportion of PVA which is found engaged in grafting increases with the dose, but it is independent of the concentration of PVA. The molecular mass of polystyrene produced is almost independent of the concentration of PVA. The role of the dispersion agent in this reaction is discussed. (tr-auth)

27074 STUDY OF SOME SYNTHESES OF THIAZANIC AND INDAMINIC DYES EXCITED BY IONIZING RADIATION. Francis Balestic (Centre d'Études Nucléaires, Saclay, France). J. chim. phys., 59: 342-58(Apr. 1962). (In French)

A new method is presented for the synthesis of methylene blue and Lauth violet by the γ rays of Co^{60}. The systematic variation of different physical chemical parameters has permitted the reaction mechanism of the radiochemical synthesis to be established and the maximum yield of the dyes to be determined. (tr-auth)

27075 THE RADIOCHEMICAL POLYMERIZATION OF PHENYLACETYLENE. Fernand Kieffer (Faculte des Sciences, Orsay, France). J. chim. phys., 59: 422(Apr. 1962). (In French)

Pure phenylacetylene, carefully degassed and dried under vacuum, was irradiated by Co^{60} γ rays. Ten-ml samples were exposed to dose intensities from 36 to 2460 r/min at room temperature. After evaporation under vacuum of the residual monomer, a yellow orange product was obtained that is soluble in acetone, benzene, esters, and CCl_4. It is insoluble in petroleum ether and alcohol, and the purified product melts at 170 to 190°C. The G values obtained are tabulated for various dose rates. (J.S.R.)

27076 KINETICS OF THE RADIOPOLYMERIZATION OF CYCLIC MONOMERS IN THE SOLID STATE. Seizo Okamura and Koichiro Hayashi (Japanese Association for Radiation Research on Polymers, Osaka). J. chim. phys., 59: 429-38(May 1962). (In French)

It was found that cyclic monomers such as trioxane, diketene, β-propiolactone, and 3,3-bischloromethylcycloxabutane are polymerized only in the solid state by irradiation with γ rays. The velocity of polymerization is proportional to the intensity and is at a maximum just below the fusion point of the monomer. A saturation for the polymer yield was observed. The polymerization proceeds by an ionic mechanism. It is assumed that the saturation is due to the disorder caused in the crystalline lattice by the presence of the polymer and a kinetic scheme is proposed. It takes into consideration the experimental results. (tr-auth)

27077 RADICAL CHARACTER OF THE RADIOCHEMICAL POLYMERIZATION OF ISOPRENE. André Hinschberger and Jean Marchal (Centre de Recherches sur les Macromolécules, Strasbourg). J. chim. phys., 59: 450-3 (May 1962). (In French)

The analysis of the absorption spectra of IR radiation shows no sensible difference between the microstructures of samples of polyisoprene obtained by irradiating at −196 and 25°C either pure isoprene or isoprene in solution in CCl_4. This result shows the radical character of the radiochemical polymerization of pure isoprene. (tr-auth)

27078 THE CHROMATOGRAPHIC SEPARATION OF RADIOACTIVE ELEMENTS ON PAPER IMPREGNATED WITH MINERAL ION EXCHANGERS. J. P. Adloff. J. Chromatog., 5: 366-7(Apr. 1961).

Filter paper was impregnated with zirconium phosphate and zirconium tungstate, rinsed, dried, and cut into bands 12 cm long and 2 cm wide. The bands were hung in an atmosphere of water vapor at 60°C and scanned with a Geiger counter at regular intervals to determine the short-lived radioisotopes. The following separations were carried out: $Pb^{211} - Tl^{207} - Tl^{204}$ (eluant HCl, time 5 min); $Pb^{212} - Bi^{212} - Ba^{140} - La^{140}$ (eluant HCl or NH_4NO_3, time 30 min); $Sr^{90} - Y^{90}$ (eluant HCl or NH_4NO_3, time 30 min); $Ra^{228} - Ac^{228} - Ra^{223} - Fr^{223} - Cs^{137}$ (eluant NH_4Cl, time 20 min); and $Tl^{+} - Tl^{3+}$ (eluant HCl, time 30 min). The separation of monovalent from trivalent thallium allows a quantitative determination of the 2 valence states of the same element. The separation of radium and francium by a rapid method is of great importance because Fr^{223} has a half-life of only 21 min. (OID)

27079 RADIOLYSIS OF BENZENE BY DENSELY IONIZING RADIATIONS. Tino Gaeumann (Technishce Hochschule) and Robert H. Schuler. J. Phys. Chem., 65: 703(1961). (RRL-55; NYO-9391)

Preliminary experiments on the radiation decomposition of benzene by cyclotron helium ions and deuterons indicate that the yield of hydrogen produced by heavy particle radiation is considerably in excess of that produced by fast electrons. The more densely ionizing particles have little effect on the yields of polymeric products. (N.W.R.)

27080 ESR SPECTRA OF POLYTETRAFLUOROETHYLENE IRRADIATED AT 77°K. N. Tamura (Tokyo Labs.). J. Polymer Sci., 60: S5-S7(July 1962).

The electron spin resonance spectra of polytetrafluoroethylene were obtained from samples irradiated in vaccum at 77°K with electrons from a Van de Graaff accelerator. When the material was examined at this temperature, a broad spectrum was obtained. With elevation of temperature the spectrum was observed to vary both in shape and in intensity. Results suggested that the primary radicals produced by irradiation may be chiefly of the scission-type radical $-CF_2 - CF_2$. (M.C.G.)

27081 SINGLE-CRYSTAL CHARACTER OF POLYOXYMETHYLENE PREPARED FROM SINGLE CRYSTALS OF TRIOXANE. J. Lando, N. Morosoff, H. Morawetz, and B. Post (Polytechnic Inst. of Brooklyn). J. Polymer Sci., 60: S24-6(July 1962).

A study was made of the orientation perpendicular to the unique axis of polyoxymethylene prepared in the solid state by gamma irradiation of single crystals of trioxane. The rotation pictures of this polymer showed 5 well-defined layer lines. Weissenberg photographs were taken of each of these layers. A high degree of three-dimensional order was observed. (M.C.G.)

27082 POLYMER CRYSTALS OBTAINED BY RADIATION POLYMERIZATION OF TRIOXANE IN SOLID STATE. S. Okamura, K. Hayashi, and M. Nishii (Japanese Assn. for Radiation Research on Polymers, Osaka). J. Polymer Sci., 60: S26-9(July 1962).

Trioxane was found to polymerize under gamma-irradiation very easily in the solid state, with no change in the outer appearance of the crystals. X-ray diagrams are presented as evidence for the apparent single crystal character of the product of the solid polymerization of trioxane. Clear and sharp maxima of the intensity of diffracted x-ray beams were observed as a function of the angle of rotation around the long axis of the polymer crystal. (M.C.G.)

27083 THE EFFECT OF THE Co^{60} γ RADIATION ON AQUEOUS SOLUTIONS OF PYRIDINE. S. A. Safarov (Karpov Inst. of Physics and Chemistry, Moscow). Kinetika i Kataliz, 3: 449(May-June 1962). (In Russian)

Study of the reaction kinetics of new product formation in aqueous solution of organic materials is helpful for determining the intermediate products formed during the radiolysis of water and may suggest new paths for the radiosynthesis of organics. The effect of Co^{60} γ quanta on aqueous pyridine solutions was investigated at a dose rate of 3.5 r/sec under an O_2 pressure of 15 atm by determining the amount of oxypyridine formed. Ultraviolet spectra indicated that the product was 4-oxypyridine with absorption maxima of 265 mμ at pH = 10 to 11 and 257 mμ at pH = 5.5. The simultaneous formation of H_2O_2 was also observed but its yield decreased with increasing pyridine concentration while that of oxypyridine continued to increase. The radiochemical yield of oxypyridine follows the equation given by M. A. Proskurnin (Doklady Akad. Nauk S.S.S.R., 135: 1446 (1960)). The yield was also found to increase with the pH, probably because in acid solutions the pyridine is present in its ionic form and therefore the H^+ ions stabilize the original molecule. (TTT)

27084 THE EFFECT OF Co^{60} γ RADIATION ON THE THIOPHENE–OXYGEN–WATER SYSTEM. S. A. Safarov and M. A. Proskurnin (Karpov Inst. of Physics and Chemistry, Moscow). Kinetika i Kataliz, 3: 450(May-June 1962). (In Russian)

The thiophene–oxygen–water system containing various amounts of the components was exposed to γ radiation under a pressure of 30 atm. Quantitative determination of α-oxythiophene and H_2O_2 formed showed that the first compound increases with increasing thiophene concentration in the original mixture. This may be due to the extraction of the α-thiophene from the solution by the thiophene or to the interaction of the excited water molecules with certain radiolytic products of thiophene. When a mixture containing 1.265×10^{-2} mole/liter of thiophene was irradiated, the α-thiophene yield did not exceed 16 to 19% of the original thiophene concentration. The radiation yield of H_2O_2 decreased as the original concentration of thiophene in the mixture was increased. (TTT)

27085 EXAMINATION OF THE MECHANISM OF CHEMICAL PROTECTIVE EFFECT IN THE RADIOLYSIS OF AQUEOUS SOLUTIONS. L. Guczi. Magyar Kem. Folyoirat, 67: 212-16(1961). (In Italian)

The effects of mercaptoacetic acid, dithiodiacetic acid, Na_2SO_3, thiourea, L-cystein, and benzoic acid on x-ray-induced oxidation of Fe^{2+} ions was investigated. The substances, except for L-cystein and benzoic acid, decreased the value of $G(Fe^{3+})$ as a function of their concentration. From these results it was concluded that the free radicals formed from the substances of redox potential smaller than 0.9 V by the effect of OH and HO_2 radicals can not oxidize the Fe^{2+} ions, and therefore their effect is protective. (auth)

27086 TIME-DEPENDENCE OF THE RADICAL STATE IN AN X-IRRADIATED KERATIN. B. Rajewsky and A. Redhardt (Max Planck-Institut fur Biophysik, Frankfurt am Main). Nature, 195: 492-4(Aug. 4, 1962).

Electron spin resonance studies were carried out on dried keratins from feather quills which were irradiated with 2.8 Mrad. The results indicate that the slow increase of the intensity in the low-frequency part of the keratin spectrum has an activation energy of 0.65 ev, there is a slow increase in the concentration of a certain radical (probably a radical state migration to the cystine part of the keratin), and the radiation reaction is indirect. (D.L.C.)

27087 FORMATION OF UNSATURATION AND CROSS-LINKS IN THE RADIOLYSIS OF n-ALKANES AND POLYETHYLENE. B. J. Lyons (British Insulated Callender's Cables, Ltd., London). Nature, 195: 690-1(Aug. 18, 1962).

The hypothesis that unsaturation decays by cross-linking if unsaturation formation and C–H scission are conceived, not as separate radiation events but as successive stages in the same radiation event, is discussed. It is not suggested that all radicals formed by C–H scission in hydrocarbons result from neutralization of olefine ions, though the extrapolated lower limit of concentration of unsaturation in the polymer fraction of paraffin wax studied by others suggests that a high proportion of the radicals formed may arise through this process. (P.C.H.)

27088 RADIATION DAMAGE TO AMINE EXTRACTANTS. I. EFFECT ON THE EXTRACTION BEHAVIOR OF URANIUM AND FISSION PRODUCTS. Takehiko Ishihara, Takeshi Tsujino, and Yoshihide Komaki (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 307-12(May 1962). (In English)

Radiation damage to 5 vol % alkyl amine–kerosene modified with lauryl alcohol was studied through the behavior changes of uranium and some fission products in extraction, scrubbing, and stripping in the nitrate system. Tested were three tertiary and four secondary amines, i.e., trioctyl amine, N-benzyl dilauryl amine, N-cyclohexyl dilauryl amine, N-cyclohexyl lauryl amine, dilauryl amine, Amberlite LA-1, and LA-2. They were irradiated to the extent of 10^8 r by Co^{60} γ ray, prior to extraction. Little changes in the extraction, scrubbing, and stripping behavior were observed in all amines tested, except N-cyclohexyl lauryl amine. The phase separation time after the mixing in ex-

traction varied very little with radiation dosage. N-cyclohexyl lauryl amine formed an emulsion even without irradiation. In the radiation resistance, amines are superior to tributyl phosphate, although the separation of uranium from fission products with amines is not as perfect as with tributyl phosphate in the nitrate system. (auth)

27089 RESEARCH OF RADIOISOTOPE PRODUCTION WITH FAST NEUTRONS. III. PREPARATION OF ^{64}Cu OF HIGH SPECIFIC ACTIVITY. Chizuko Shikata and Eiji Shikata. Nippon Genshiryoku Gakkaishi, 4: 390-7(1962). (In English)

Preparation of Cu^{64} of high specific activity by the reaction $Zn^{64}(n,p)Cu^{64}$ was investigated. Five grams of zinc oxide were irradiated in-pile for 5 hr. Cu^{64} produced was separated from zinc by anion exchange or by a combination of organic co-precipitation and anion exchange. About 1 mC of Cu^{64} with a specific activity of more than 2.5×10^6 mC/g Cu at best was prepared. The use of an organic co-precipitation reduced processing time. Some comparisons were made to use of a Szilard-Chalmers process to prepare Cu^{64} of high specific activity. (auth)

27090 NOMOGRAMS FOR DETERMINING THE ACTIVITY OF TELLURIUM-132 NECESSARY FOR OBTAINING THE ACTIVITY OF IODINE-132. R. Stiennon-Bovy and G. Geladi (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Nucl. Med., 2: 61-6(1961). (BLG-78). (In French)

The importance of iodine-132 for medical applications has been proved very often. In view of the short life of this isotope (2.4 hr) it has to be kept under the form of its parent tellurium-132 (77 hr) wherefrom it can be easily separated by chromatography on aluminum. Two nomograms are presented which enable the determination of the activity A of tellurium-132 required, if, for n days, and providing m separations per day, one needs either a daily activity of iodine-132 at least equal to a given activity a (nomogram I), or every day a certain activity of iodine-132 which adds up to a given total activity s (nomogram II). (auth)

27091 OLFACTORY CHANGES IN IRRADIATED ESSENTIAL OILS. P. R. Hills, P. T. Petley, and R. Roberts (Wantage Research Lab., Berks, Eng.). Perfumery Essent. Oil Record, 52: 4p. (July 1961).

Studies showed that the olfactory properties of a range of essentail oils may be improved by exposure to high-energy radiation. Samples were irradiated in stoppered tubes with either electrons or gamma rays and evaluated by their olfactory properties when examined on strips of absorbent paper. The physical properties were virtually unaffected by radiation. The changes in odor observed were not very pronounced. They were most noticeable on the freshly impregnated test strips. After 2 hours evaporation, differences between the treated and untreated samples were in most cases no longer apparent. Within the range of materials tested the order of radiation stability appeared to be aldehyde > alcohol > ester > hydrocarbon > phenol. For floral oils radiation enhanced fidelity to the flower. Peppermints were improved in odor and flavor, and radiation appeared to inhibit the spontaneous decomposition of citrus oils. Of the 47 oils assessed, 31 were improved, 8 deteriorated, and 8 were not affected. (M.C.G.)

27092 POLYMERIZATION OF VINYL CHLORIDE UNDER EFFECT OF γ-RADIATION. L. D. Bubis, V. L. Karpov, Yu. M. Malinskii, and D. M. Yanovskii. Plasticheskie Massy, No. 4, 3-6(1962).

Experiments were conducted on the polymerization of technical vinyl chloride under the effect of γ radiation at -78, -20, 0, and 20°C in an atmosphere of nitrogen. Co^{60} with an activity of 18,000 g-equiv Ra was used as the source. The polymerization kinetics was shown to obey the general laws governing free radical polymerization. There is a considerable induction period, because the initial radicals react with inhibiting impurities contained in the monomer. The process was shown to follow the bimolecular mechanism. Increase of the dose rate accelerated the polymerization but reduced its yield. The total activation energy of the polymerization was calculated to be 4.7 kcal/mole. The curve plotted for intrinsic viscosity vs. polymerization temperature had a maximum at -20°C. The intrinsic viscosity and the thermal stability of the polymer rose with an increase of the degree of conversion, attained a maximum at ~20% conversion, and then dropped. The increase was due to a reduction of the concentration of impurities and of their effect on the polymer properties, while the drop at higher degrees of conversion was due mainly to a degradation of the polymer. The use of a high-purity monomer is recommended, as well as the prevention of exposure of the polymer to radiation by its continuous removal from the radiation zone (e.g., by precipitation of the insoluble polyvinylchloride from the monomer solution). The glass transition temperature of polyvinylchloride obtained under the effect of γ-radiation was ~100°C. (OTS)

27093 RADIATION-INDUCED FREE RADICALS IN FROZEN AQUEOUS SOLUTIONS OF GLYCINE. Thormod Henriksen (Norsk Hydro's Inst. for Cancer Research, Montebello, Oslo). Radiation Research, 17: 158-72(Aug. 1962).

Radiation-induced free radicals in frozen aqueous solutions of glycine have been studied by electron spin resonance spectroscopy. At 77°K the resonance spectra exhibit the composite patterns of ESR centers induced in water as well as in the glycine molecules. The water resonance at 77°K is ascribed to OH radicals and some unidentified ESR species. The radiation yield for all ESR centers in H_2O at 77°K is found to be G = 1.0. About 50% is presumed to be OH radicals. The water resonance is relatively unstable and disappears rapidly in the temperature range 100 to 120°K, whereas the glycine radicals are much more stable and may be observed at temperatures nearly up to the melting point of the solution. The glycine radicals are proposed to be $^+NH_3\dot{C}HCOO^-$ and $\cdot CH_2COO^-$. The results show that the number of glycine radicals increases almost linearly with the concentration. These data seem to indicate that the major fraction of the glycine radicals induced at 77°K is the result of the direct action of radiation. Based on this assumption, the yield for glycine radicals is found to be G = 4.4. (auth)

27094 INTRAMOLECULAR DISTRIBUTION OF TRITIUM IN LABELED INDEFINITE ORGANIC COMPOUNDS PREPARED BY HOT SYNTHESIS (CYCLOHEXENE AND 1,3 CYCLOHEXADIENE). V. V. Pozdeev, Ya. Klas, A. N. Nesmeyanov, and B. G. Dzantiev. Radiokhimiya, 4: 215-20(1962). (In Russian)

Studies of distributions of tritium-labeled cyclohexene and 1,3 cyclohexadiene prepared by hot synthesis indicate that tritium distribution in cyclohexene differs from equipotential while in 1,3 cyclohexadiene the distribution is equipotential. (R.V.J.)

27095 RADIOACTIVE CARRIER-FREE BISMUTH IN n-BUTYL ALCOHOL. B. Z. Iofa and V. N. Vysotskii. Radiokhimiya, 4: 238-41(1962). (In Russian)

An analysis of carrier-free Bi^{210} in n-butyl alcohol at various hydrogen chloride concentrations revealed a relation between the colloidal, molecular, and ion forms of

radioactive bismuth and the acidity. The bismuth was extracted from water by n-butyl alcohol as an acid complex with negatively charged colloids. (R.V.J.)

27096 DIFFRACTION ELECTRON METHOD IN STUDIES OF REACTOR OR THERMAL OXIDATION OF Ag FILMS. I. Teodoresku and G. Glanz. Rev. phys., Acad. rép. populaire Roumaine, 6: 483-9(1961). (In Russian)

The structure of AgO crystals produced by the reactor irradiation of silver in oxygen was different from the structure described in published literature. Electron-diffraction measurements show AgO crystallized cubically with a = 5.53 Å. Compounds of Ag_2O also crystallized cubically with a = 9.84 Å. However, Ag_2O compounds were not observed in irradiated and thermally treated specimens. It was concluded that the strong oxidation during reactor irradiation was caused by γ radiation forming molecular ions or oxygen atoms. It is postulated that the fast neutron flux contributes to oxidation by forming high thermal peaks and defects in the lattice. (R.V.J.)

27097 EFFECT OF GAMMA RADIATION ON CHEMICAL STRUCTURE OF PLASTICS. V. J. Krasnansky, B. G. Achhammer, and M. S. Parker (National Bureau of Standards, Washington, D. C.). SPE (Soc. Plastics Engrs.) Trans., 1: 133-8(1961).

A study was made of the effects of Co^{60} gamma radiation on the chemical structure of certain plastics. Plastic films were exposed to a total dosage of 6 Mr and to other dosages for particular material. The irradiated films were examined by infrared spectrophotometry. The gases evolved from the films were examined by mass spectrometry. Results indicated that the materials most stable to irradiation contain a phenyl group, an amide linkage, and possibly chlorine atoms. (M.C.G.)

27098 SOVIET CHEMISTRY TODAY. Its Present State and Outlook for the Future. V. I. Spitsyn (Akademiya Nauk S.S.S.R. Institut Fizicheskoi Khimii). A Series of Six Lectures. 1961. 307p.

Six lectures are presented on various aspects of chemistry being studied in Russia. Separate abstracts were prepared for three of the papers which deal respectively with radiation effects on heterogeneous chemical processes, with radiochemistry, and with radiation chemistry. The remaining three papers cover chemical science in Russia, basicity of heteropoly acids and high substitution salts, and chelate compounds. (D.L.C.)

27099 NEW DATA ON THE EFFECT OF RADIOACTIVE RADIATION OF SOLIDS AND EXTERNAL RADIATION ON SOME HETEROGENEOUS CHEMICAL PROCESSES. V. I. Spitsyn (Inst. of Physics and Chemistry, Academy of Sciences, USSR). p.94-135 of "Soviet Chemistry Today." Washington, D. C., National Academy of Sciences and National Research Council. 1961.

Studies on the effects of radioactivity and radiation on various heterogeneous chemical processes are reviewed in some detail. Studies reviewed include (1) S^{35} exchange in K_2SO_4-SO_2 and Na_2SO_4-SO_3 systems with and without electron irradiation, (2) O^{18} exchange in $Na_2S^{35}O_4$-O_2^{18}, (3) sorption of methylene blue, acid orange, and brilliant green on $BaSO_4$ containing S^{35} or radium and on non-active $BaSO_4$ with electron or proton irradiation, (4) methanol vapor sorption by K_2SO_4 containing S^{35}, (5) cyclohexanol dehydration with $MgSO_4$–Na_2SO_4 containing S^{35} and with $MgSO_4$ in the presence of electrons, (6) dissolution of $BaSO_4$ containing S^{35} in water, and (7) solubility of cerium(III) oxalate labeled with Ce^{144} in water. (D.L.C.)

27100 RECENT ADVANCES OF RADIOCHEMISTRY IN THE USSR. V. I. Spitsyn (Inst. of Physics and Chemistry, Academy of Sciences, USSR). p.136-78 of "Soviet Chemistry Today." Washington, D. C., National Academy of Sciences and National Research Council. 1961.

A review is presented of the most important results of Soviet work in radiochemistry in 1958 to 1960. The topics reviewed include coprecipitation of mixed crystals, adsorption of radioisotopes, chromatographic separation of radioisotopes, radiation effects on ion exchange resins, solvent extraction, and chemistry of Pu and other elements. (D.L.C.)

27101 THE DEVELOPMENT OF RADIATION CHEMISTRY IN THE U.S.S.R. V. I. Spitsyn (Inst. of Physics and Chemistry, Academy of Sciences, USSR) and A. K. Pikaev. p.179-248 of "Soviet Chemistry Today." Washington, D. C., National Academy of Sciences and National Research Council. 1961.

A review of developments in Russian radiation chemistry is presented. The systems discussed include water, aqueous solutions, inorganic molecules, organic substances, and polymers. Radiation polymerization and radiation chemistry mechanisms are considered. (D.L.C.)

27102 IRRADIATION METHOD OF CONVERTING HYDROCARBONS. (to U. S. Atomic Energy Commission). British Patent 900,417. July 4, 1962.

A method for irradiating hydrocarbons is described which enables the ratios of radiolytic products to be changed, e.g., to increase the amount of branching. In this method, a deposit of the hydrocarbon from 10 to 0.1 times the monomolecular average thickness is formed on an inert solid which has a specific surface $>1 m^2$, the deposit is irradiated to a dose >100,000 rad, and the solid is separate from the deposit. The solid may be a metal, oxide, sulfide, halide, or clay. Examples of the method are given in which pentane is irradiated. (D.L.C.)

27103 IMPROVEMENTS IN OR RELATING TO POLYMERIC MATERIALS. Maurice Stacey, Sidney Alan Barker, Richard Bernard Ward, Peter Malcolm Grant, and Ian Richard Lane Lloyd (to United Kingdom Atomic Energy Authority). British Patent 901,037. July 11, 1962.

Novel polymers may be prepared by irradiation in absence of O_2 of hydroxycarboxylic acids, amino acids, and substances yielding such acids under the production conditions. The acidic polymers which are produced are water-soluble but may be made insoluble by heat. Examples of the process are given in which glucose, gluconic acid lactone, lactic acid, glycolic acid, etc. are irradiated to form polymers. (D.L.C.)

27104 IMPROVEMENTS RELATING TO BIOLOGICALLY ACTIVE POLYMERS. (to E. I. du Pont de Nemours and Co.). British Patent 901, 039. July 11, 1962.

A method is given for producing biologically active polymers which may be used as bacteriostats, fungistats, and insecticides. The method comprises grafting side chains with biologically active groups onto a polymeric substrate by means of exposure to ionizing radiation. Polymers and monomers which may be used are described, and many examples of the method are given along with observations on the activity of the products. (D.L.C.)

27105 PROCESS FOR THE PRODUCTION OF ELASTOMERS. Herbert Bartl and Hans Scheurlen (to Farbenfabriken Bayer Aktiengesellschaft). British Patent 901,117. July 18, 1962.

A process for the production of elastomers, particularly from copolymers of ethylene and vinyl esters is described. The copolymers to be cross-linked may be prepared by any suitable method. The cross-linking is produced by the action of ionizing rays. The copolymers may be mixed with fillers before irradiation. The process may be used on ar-

ticles of any desired shape, such as foils, plates, tires, pipes, bottles, or textile coatings. (M.C.G.)

27106 IRRADIATION OF ORGANOPOLYSILOXANES. Alexander A. Miller (to General Electric Co.). U. S. Patent 3,046,207. July 24, 1962.

A method is outlined for introducing Si-H groups into organopolysiloxanes. The method comprises irradiating an organopolysiloxane containing at least 50 mole % of lower alkyl groups, in the presence of a hydrogen transfer agent containing a mercapto group. A high-voltage apparatus for producing high-energy electron beams is described. (D.L.C.)

27107 RADIOLYSIS OF MONOOLEFINS WITH A SENSITIZER. Carl E. Heath and Peter J. Jucchesi (to Esso Research and Engineering Co.). U. S. Patent 3,046,208, July 24, 1962.

A process is outlined for alkylating a hydrocarbon with a monoolefin. The process comprises irradiating a monoolefin containing 2 to 8 C atoms in admixture with a saturated hydrocarbon containing 1 to 20 C atoms, in the presence of 0.1 to 15 wt % of a halogenated hydrocarbon containing 1 to 6 C atoms, until a total of ≥ 0.01 kwh of radiant energy per pound of product was absorbed. The product comprises hydrocarbons having at least two alkyl side chains and may be used in gasolines. Examples of the process are given in which isobutane–propene mixtures are irradiated under varying conditions. (D.L.C.)

27108 RADIOCHEMICAL SULFONATION REACTION. Eugene L. Stogryn and Perry A. Argabright (to Esso Research and Engineering Co.). U. S. Patent 3,048,531, Aug. 7, 1962.

A process for the sulfonation of type I olefins is given which results in high yields. The process comprises forming a mixture of the olefin and a metal bisulfite and irradiating the mixture with x and gamma rays (wavelength 10^{-3} to 10^{2} A). The product is an organic sulfonate with the formula $(RCH_2CH_2SO_3)_xM$. An example of the process is given in which the use of radiation increased the yield of sodium hexane sulfonate from 1-hexene from 10.1 to 34 wt %. (D.L.C.)

Raw Materials and Feed Materials

27109 PURIFICATION OF CALCIUM AND MAGNESIUM PRECONCENTRATES AT THE GUEUGNON PLANT (SAONE-et-LOIRE). E. Roques and P. Sugier. Bull. inform. sci. et tech. (Paris), No. 59, 58-63(Mar. 1962). (In French)

A brief outline is given of the process development by the C.E.A. for the treatment for the calcium uranate and magnesium uranovanadate preconcentrate. The equipment at the Gueugnon plant for the utilization of this process is described, and the principal results obtained on both the calcium-containing preconcentrate and on the uranovanadates from Mounana (Gabon Republic) are given. (J.S.R.)

27110 SOLVENT EXTRACTION OF URANYL NITRATE. J. Durandet, X. Talmont, Ph. Renault, Y. L. Gladel, and P. Regnaut (Centre d'Études Nucléaires, Saclay, France). Chim. and Ind. (Paris), 86: 29-38(1961). (CEA-2145). (In French)

The transfer of uranyl nitrate from an aqueous acid phase into a solvent (dilute tributyl phosphate) is attended by nitric acid transfer. In these conditions, equilibrium data cannot be represented by a plane curve, which complicates the determination of the efficiency of the extractor used, i.e., the calculation of either the number of theoretical plates or the number of transfer units equivalent to the apparatus. A simple method is presented for estimating the efficiency of a column, based upon either uranium or acid transfer. This method can be used when the profile of uranium and acid concentrations in a phase circulating in the equipment has been previously determined. On another hand, it enables one to study the variation of local efficiency, i.e., the efficiency of different sections of the column. (auth)

27111 BERYLLIUM EXTRACTED BY THE FLUORIDE PROCESS. S. J. Morana and G. F. Simons (Beryllium Corp., Hazleton, Penna.). J. Metals, 14: 571-4(Aug. 1962).

The steps used in producing high-purity BeO and beryllium metal, including recent modifications to production processes, are described. Particular emphasis is placed on the fluoride extraction process in which beryllium is attacked preferentially, and beryllium oxide is converted into a water-soluble form of beryllium fluoride so that no additional chemicals are required to react with other materials present in beryl ores. Beryllium is processed from the ore in four major steps: the beryl ore is converted into a standard grade of beryllium hydroxide, the hydroxide is purified, purified beryllium hydroxide is reacted with ammonium bifluoride for conversion into ammonium beryllium fluoride, and then reduced to beryllium metal. The fluoride process is attractive economically and offers an additional advantage of versatility. (auth)

27112 EFFECTS OF ANIONS ON LEACHING OF RADIOACTIVE ELEMENTS FROM MINERALS. I. E. Starik and K. F. Lazarev. Radiokhimiya, 4: 193-8(1962). (In Russian)

The presence of SO_4^{2-} and CO_3^{2-}, which form complex compounds with Th and U, aid the leaching-out of these elements from monazites. (R.V.J.)

27113 PROCESS FOR THE EXTRACTION OF THORIUM. Ronald Alfred Wells, Arthur John Head, and Norman Frank Kember (to United Kingdom Atomic Energy Authority). British Patent 900,452. July 4, 1962.

A process for extracting Th from acidic aqueous solutions is outlined which uses a phosphorylated cellulose to effect the extraction. The phosphorylated cellulose is prepared in a way according to British Patent 899,284 and the hydrogen form allowed to stand in water for at least 3 days. The improvement in Th adsorption relative to phosphate adsorption with standing in water is shown. (D.L.C.)

27114 RECOVERY OF URANIUM FROM ZIRCONIUM-URANIUM NUCLEAR FUELS. T. A. Gens (to U. S. Atomic Energy Commission). U. S. Patent 3,043,653. July 10, 1962.

An improvement was made in a process of recovering uranium from a uranium-zirconium composition which was hydrochlorinated with gaseous hydrogen chloride at a temperature of from 350 to 800°C resulting in volatilization of the zirconium, as zirconium tetrachloride, and the formation of a uranium containing nitric acid insoluble residue. The improvement consists of reacting the nitric acid insoluble hydrochlorination residue with gaseous carbon tetrachloride at a temperature in the range 550 to 600°C, and thereafter recovering the resulting uranium chloride vapors. (AEC)

27115 METHOD OF URANIUM RECOVERY. Augustin Driessen and Henri de Saint-Chamant (to Centre d'Etudes et de Recherches des Phosphates Mineraux Cerphos). U. S. Patent 3,044,848. July 17, 1962.

A method is described for recovering U from slag by-product of elemental phosphorus furnaces in an economical manner. The method comprises treating the slag with an

acid (5 to 6 N) to dissolve most of the calcareous constituents while retaining most of the U in the solid siliceous residues, and extracting the U from the filtered solid residues. The acid may be any acid except H_2SO_4, and the U extraction may be done with soda carbonate or H_2SO_4. (D.L.C.)

27116 PREVENTION OF SETTLING OF URANIUM PULP BY POLYVINYL ALCOHOL. Frederick W. Matthews and Max Morf (to Canadian Industries Ltd.). U. S. Patent 3,044,849. July 17, 1962.

A method is given for keeping U ore pulp in suspension for leaching with H_2SO_4. The method comprises incorporating polyvinyl alcohol in the pulp to a concentration of at least 0.01 lb/ton U ore. (D.L.C.)

27117 PROCESS OF TREATING URANIUM HEXAFLUORIDE AND PLUTONIUM HEXAFLUORIDE MIXTURES WITH SULFUR TETRAFLUORIDE TO SEPARATE SAME. Martin J. Steindler (to U. S. Atomic Energy Commission). U. S. Patent 3,046,089. July 24, 1962.

A process was developed for separating uranium hexafluoride from plutonium hexafluoride by the selective reduction of the plutonium hexafluoride to the tetrafluoride with sulfur tetrafluoride at 50 to 120°C, cooling the mixture to −60 to −100°C, and volatilizing nonreacted sulfur tetrafluoride and sulfur hexafluoride formed at that temperature. The uranium hexafluoride is volatilized at room temperature away from the solid plutonium tetrafluoride. (AEC)

27118 PURIFICATION OF CRUDE THORIUM SULFATE. Clifford W. Kline and Wallis R. Bennett (to Dow Chemical Co.). U. S. Patent 3,047,359. July 31, 1962.

A process was developed for purifying crude wet-cake thorium sulfate containing, as major impurities, sulfates of iron, yttrium, and rare earth elements. A solution of the crude thorium sulfate was prepared from the wet cake by dissolving it in water at 20 to 50°C so as to obtain between 0.75 and 5 wt % of dissolved thorium sulfate in the solution. The solution was heated to a temperature between 80°C and boiling and maintained there until at least a portion of the thorium sulfate therein precipitated in the form of a crystallized thorium sulfate hydrate. The precipitated and purified sulfate was separated from solution by filtration. (M.C.G.)

27119 PROCESS FOR EXTRACTING NEPTUNIUM AND PLUTONIUM FROM NITRIC ACID SOLUTIONS OF SAME CONTAINING URANYL NITRATE WITH A TERTIARY AMINE. John C. Sheppard (to U. S. Atomic Energy Commission). U. S. Patent 3,047,360. July 31, 1962.

A process of selectively extracting plutonium nitrate and neptunium nitrate with an organic solution of a tertiary amine, away from uranyl nitrate present in an aqueous solution in a maximum concentration of 1M is described. The nitric acid concentration is adjusted to about 4M and nitrous acid is added prior to extraction. (AEC)

Separation Processes

27120 (HW-69027) DEMONSTRATION OF AN IRRADIATED UO_2 FUEL RECYCLE: FIRST RECYCLE. J. L. Swanson, G. E. Benedict, R. C. Smith, and G. R. Horn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1961. Contract AT(45-1)-1350. 29p.

Irradiated UO_2 was processed for recycle by one version of the Salt Cycle Process. The irradiated fuel was dissolved in fused NaCl-KCl and the bulk of the uranium and plutonium were recovered as UO_2 and PuO_2 by electrodeposition. A reduction in the concentration of fission product poisons in the fuel was also achieved in the electrodeposition step. Fabrication of the partially decontaminated, irradiated UO_2 into a fuel rod and subsequent incorporation of the fuel rod into a four-rod cluster fuel element was accomplished by remote handling techniques. Two rods of the cluster contained nonrecycled, electrodeposited UO_2, one contained sintered UO_2 pellets, and the fourth contained the recycled, electrodeposited UO_2. The element was irradiated in the MTR with a maximum surface heat flux of approximately 300,000 Btu/(hr)(sq ft) to an exposure of approximately 450 MWD/T. The fuel rods containing electrodeposited UO_2 (both recycled and nonrecycled) suffered no adverse effects during irradiation. (auth)

27121 (HW-SA-2569) A STUDY OF THE MASS TRANSFER CHARACTERISTICS OF A FLUIDIZED-BED ION-EXCHANGE COLUMN (thesis). Gilbert Allen Nicholson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1962. Contract [AT(45-1)-1350]. 54p.

Submitted to Univ. of Idaho, Moscow.

The eddy diffusion characteristics of packed and fluidized-bed ion-exchange columns were determined and compared qualitatively with adsorption characteristics obtained with $UO_2(NO_3)_3^{-}$ at similar flow conditions. Attempts were made to develop a method for predicting adsorption behavior from a knowledge of the mass-transfer, eddy diffusion, and equilibrium distribution characteristics of the systems. It was concluded that, for the system under study, the most reliable method of predicting the adsorption characteristics of operating ion-exchange columns, consisted of a qualitative prediction based on laboratory adsorption studies and the effect of scale-up on the eddy diffusion characteristics. (auth)

27122 (NYO-9174) THE DECONTAMINATION AND RECOVERY OF PRECIOUS METALS. Quarterly Progress Report, October 2, 1960 to December 1, 1960. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT(30-1)-2528. 36p.

Progress is reported on the decontamination and recovery of precious metals from contaminated scrap. It was confirmed that liquid-liquid solvent extraction not only achieves the desired decontamination, but also produces a product of high purity. The dissolution of Au-Pd-Pt and Pt-Rh alloys and Pt by chlorination in a sodium chloride matrix was studied. Ethyl acetate was used as organic solvent in the solvent extraction studies. A solvent extraction flow sheet was developed. (M.C.G.)

27123 (ORNL-TM-187) HOT CELL DEMONSTRATION OF ZIRFLEX AND SULFEX PROCESSES. Report No. 3. J. H. Goode and M. G. Baillie (Oak Ridge National Lab., Tenn.). May 14, 1962. Contract [W-7405-eng-26]. 26p.

Hot cell demonstration of the Zirflex decladding process coupled with a modified Purex solvent extraction process was completed using specimens of Zircaloy-clad UO_2 irradiated to levels of 6150-14,600 Mwd/TU. Soluble losses of uranium and plutonium to the decladding solutions were about 0.05%. Centrifugation of the decladding solution is probably necessary to remove up to 1% of the UO_2 present as fines resulting from the fracture of low (93 to 95%) density pellets; high (96%) density pellets produced few fines. Approximately 5 hours were required to dissolve the UO_2 core material (14,000 Mwd/TU) in 4M HNO_3 versus 6 to 7 hours for unirradiated pellets to produce a solvent extraction feed of 100 g U/l and 3M HNO_3. Gamma decontamination factors for uranium in the Purex CU stream and plutonium in the BP stream were increased by factors of

2 to 10 from the normal 1.3×10^3 and 2.1×10^3, respectively, by pretreatment of the solvent extraction feed with diacetyl monoxime or its degradation product, oxalic acid. Preliminary data indicate radiation damage degrades the solvent, 30% TBP diluted with Amsco 125-82, upon one pass through the mixer-settler banks with feed solutions irradiated to levels greater than 12,000 Mwd/T causing a decrease in Zr "Z" test by a factor of 15. (auth)

27124 (ORNL-TM-257) PROCESS DESIGN SECTION STATUS REPORT FOR APRIL 1962. H. E. Goeller (Oak Ridge National Lab., Tenn.). May 31, 1962. Contract [W-7405-Eng-26]. 28p.

The accomplishments of the Process Design Section of the Chemical Technology Division during the month of April 1962 are summarized. The five major projects discussed are transuranium, volatility, power reactor fuel processing, waste studies, and thorium fuel cycle development. Smaller programs are also reviewed along with project engineering accomplishments and status. (auth)

27125 (TID-16397) FOAM SEPARATION. Quarterly Progress Report No. 2, October 1, 1960–December 31, 1960. (Radiation Applications Inc., Long Island City, N. Y.). Jan. 25, 1961. For Oak Ridge National Lab. Contract [W-7405-eng-26], Subcontract 2024. 40p.

Commercially available foaming agents effective in foam separation of Cs, Sr, and Ce were screened. Only Maypon 4C, a protein condensate of a fatty acid, gave promising enrichment for cesium at low pH. Several compounds enriched strontium at pH 12, and Igepon T-33 proved effective for cerium. A study of the rate of liquid drainage through a rising foam bed was initiated. Preliminary results show the rate of drainage increases linearly with the liquid rate, at constant gas flow rates. A theoretical treatment of surface adsorption is presented based on the Langmuir adsorption hypothesis. The distribution coefficients for components in a multicomponent system are expressed such that they can be calculated from surface tension data of the components. Consideration of the reversible reactions occurring in the bulk solution and at the gas-liquid interface, and of the equilibrium constants lead to the conclusion that, for a 1 : 1 complexing agent, the distribution coefficient of the metal chelate is the same as that for the unchelated foaming agent. Experimental evidence of this is given for the case of strontium and DBDTTA. For this system the experimental effects of foaming agent and metal ion concentrations are in accordance with the theoretical considerations. Comparison of the dynamic and static methods for determining the distribution coefficients show the Γ/C values, for the system water-RWA-100, to be the same in either case. Separation of the rare earth metal ions by foaming was obtained at pH 6-8 using a sulfonate type foaming agent. (auth)

27126 (TID-16398) FOAM SEPARATION. Quarterly Progress Report No. 3, January 1, 1961–March 31, 1961. (Radiation Applications Inc., Long Island City, N. Y.). Apr. 26, 1961. For Oak Ridge National Lab. Contract [W-7405-eng-26], Subcontract 2024. 22p.

Commercially available foaming agents were screened for those effective in foam separation of Cs, Sr, and Ce. The screened group consisted of 17 surfactants: 11 anionic, 5 nonionic, and 1 cationic; 13 out of the 17 proved to give a reasonably good foam at one or more pH, and were tested for enrichment. The following general results were obtained from the enrichment tests of these 13 surfactants: the nonionic foaming agents gave very low or no separation; the anionic foaming agents usually gave at least some separation of cerium and strontium; with anionic foaming agents, cerium is usually best separated at neutral and acidic pH ranges; strontium at neutral and basic pH ranges and cesium at neutral pH ranges. Three surfactants in the group gave distribution factors for Cs^+ which were equal to or larger than 1×10^{-4}—all at pH 7. Several studies were conducted on the variables which affect foam separation (bubble diameter, foam ratio, foam linear velocity and flow rate, drainage time, foaming agent concentration). Using Aerosol 22 at pH-4, the experimental results indicate that: at constant height of foam column, a plot of the logarithm of foam ratio x bubble diameter ($\log \frac{1}{2} \cdot D$) vs drainage time gives a straight line; the factor $\frac{1}{2} \cdot D$ is probably independent of foaming agent concentrations for a relatively wide concentration range; and a plot of $1/\frac{1}{2} \cdot D$ vs enrichment ratio for Sr gives a straight line, whereas the distribution factors remain constant, thus indicating that the equation used in calculating the distribution factors is probably correct. (auth)

27127 (AEC-tr-5071) RADIATION DAMAGE TO TBP/KEROSENE SOLVENT EFFECT ON BEHAVIORS OF FISSION PRODUCTS AND NITRIC ACID. Takehiko Ishihara, Takeshi Tsujino, and Yutaka Yamamoto. Translated from Nippon Genshiryoku Gakkaishi, 2: 659-70 (1960). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 6059.

27128 (AEC-tr-5320) CYCLIC ETHER EXTRACTION. Marko Branica. Translated for Oak Ridge National Lab., Tenn. from p.60-70 of "Dotyczace Zagadnien Ekstrakcji W Technice Jadrowej. Jugoslowiansko–Polskie, Kolokwium, Kowary, 7-13 Wrzesien 1961." 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 13146.

27129 (EURAEC-263) RETREATMENT OF IRRADIATED FUELS. Quarterly Report No. 3 (2nd year), October through December 1961. (Brussels. Centre d'Etude de l'Energie Nucléaire). Work performed under United States–Euratom Joint Research and Development Program. Contract 049-61-4-RDB. 29p. A translation.

Results of a chlorination study showed that UCl_4 can be prepared from UO_2 by reaction with chloroform. Process cycles for preparation of UF_6 from UC recovered from irradiated fuels were studied for decontamination improvement. Favorable conditions were found for elimination of I_2 and Ru. Fluidized bed conversion of UC to UF_6 is being investigated. (J.R.D.)

27130 (KFK-tr-103) TRENNUNG VON TRAGERFREIEM RHODIUM 102 AUS EINEM RUTHENIUM-TARGET. (Separation of Carrier-Free Rhodium-102 from a Ruthenium Target). H. Shimojima. Translated into German by Peter Buriks (Kernforschungszentrum, Karlsruhe, Ger.) from Nippon Kagaku Zasshi, 81: 561-4 (Apr. 1960). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 11072.

27131 (OTS-61-31210) CHEMISTRY OF EXTRACTION PROCESSES. V. V. Fomin. Translation of "Khimiya Ekstraktsionnykh Protsessov" (a publication of the State Publishing House of Literature on Nuclear Science and Techniques, Moscow, 1960). 149p. (PST-Cat.-802)

A new classification of the problems with which solvent extraction of inorganic compounds is concerned is presented. Emphasis is placed on the use of experimental results to elucidate the mechanisms of the heterogeneous reactions involved in extraction processes. An attempt is made to summarize the existing concepts on the mechanisms of extraction, the dependences of the distribution

coefficient on the conditions of extraction, the methods employed to achieve this aim, and to note the contradictions, and, where possible, to resolve them. Detailed numerical calculations, especially in the presentation of the usual methods of investigation such as spectral studies and solubility diagrams are excluded. Methods that are widely applied, such as the investigation of the dependence of the distribution coefficient on the concentration of the extractant for the determination of the solvation number are briefly reported. Lengthier consideration is given to the problem of deviations from general regularities occurring at higher solute concentrations and other cases. 236 references are given. (P.C.H.)

27132 ON THE CHEMISTRY OF AQUEOUS FUEL-RECUPERATION. W. Knoch (Chalmers Tekniska Hogskola, Göteborg). Atompraxis, 8: 257-61(July 1962). (In German)

Chemical reactions involved with the dissolution of irradiated fuel elements and succeeding separation of fissile material and fission products are summarized. (auth)

27133 SEPARATION OF URANIUM, PLUTONIUM AND FISSION PRODUCTS ON ZIRCONIUM PHOSPHATE. PART 1. ADSORPTION EQUILIBRIA AND KINETICS. Ivan Gal and Aleksandar Ruvarac. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 13: No. 1, 1-17(Apr. 1962). (In English)

The distribution coefficients of UO_2^{2+}, PuO_2^{2+}, Pu^{3+}, Pu^{4+}, Fe^{3+}, $^{137}Cs^{+}$, $^{90}Sr^{++}$, $^{95}Zr^{4+} + ^{95}Nb^{5+}$, ^{106}Ru, and $^{144}Ce^{3+}$ were determined in the system $Zr(PO_4)_2$ HNO_3. As for the exchange reaction Cs^+/H^+ and $Sr^{++}/2H^+$, it was shown that the mass action law can be applied. For these reactions the corresponding equilibrium constants were calculated. The rates of adsorption of Cs^+, Sr^{2+}, Fe^{3+}, and Pu^{4+} from solutions of a fixed HNO_3 concentration were studied, and empirical rate equations were derived. The experimental data confirm that UO_2^{2+} can be separated from Pu^{4+}. Among the fission products, Sr^{90}, Ru^{106}, and Ce^{144} mainly follow the fraction of uranium while Cs^{137}, Zr^{95}, and Nb^{95} follow the plutonium fraction. Separations within the fractions are possible. (auth)

27134 SEPARATION OF IODINE, ARSENIC(III) AND TELLURIUM(VI) BY PAPER CHROMATOGRAPHY. Natalija Cvjetićanin and Vera Jovanović. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 13: No. 1, 43-51(Apr. 1962). (In English)

Ascending paper chromatography was used for the separation of iodides, arsenites, and tellurates. The method was used to check the purity of I^{131}. A methyl alcohol-water mixture in a proportion of 9:1 was used as a solvent. (auth)

27135 THE EXTRACTION OF THORIUM AND SOME LOWER LANTHANIDE NITRATES BY DIBUTYL BUTYL PHOSPHONATE. P. G. Manning (Dept. of Mines and Technical Surveys, Ottawa). Can. J. Chem., 40: 1684-9(Aug. 1962).

The distribution of thorium and a number of lanthanides between nitric acid and solutions of dibutyl butyl phosphonate in odorless kerosene has been examined as a function of the aqueous nitric acid concentration. Experiments were conducted at trace metal concentration using radioisotopes. Separation factors (denoted by S and defined as the ratio of the distribution coefficients, K, for two metal species) have been measured for some lanthanide–lanthanide couples and also for some thorium–lanthanide couples. Results indicate that separation factors between successive lanthanides (given by $S = K_{Z+1}/K_Z$) at the lower end of the rare-earth series are superior to those obtained with either tributyl phosphate (TBP) (D. Scargill et al., J. Inorg. & Nuclear Chem., 4: 304(1957)) or trioctyl phosphine oxide (TOPO) (J. M. Schmitt. Oak Ridge National Laboratory. Unpublished data), but as Z increases, $S_{DBBP} \sim S_{TBP} > S_{TOPO}$. For thorium–lanthanide couples, $S'_{DBBP} > S'_{TBP}$. Measurements over a range of extractant concentrations indicate that the lanthanides are extracted as trisolvates. (auth)

27136 CHEMICAL EUROPIUM SEPARATION FROM THE RARE EARTH ELEMENTS. V. Baran (Inst. for Nuclear Research, Czechoslovak Academy of Science, Rez). Collection Czechoslov. Chem. Communs., 27: 1337-40(May 1962). (In German)

A method for Eu separation from the rare earth elements was worked out. The method depends on the small solubility of $EuSO_4$ in comparison with the sulfates of the trivalent lanthanides. The extensively reduced sensitivity of Eu^{2+} in the crystal lattice to oxidizing media in comparison with Eu^{3+} salts in the dissolved state was used in this method. The method can be used advantageously in the radiochemical isolation of Eu isotopes from fission product mixtures. The high chemical yield and good reproducibility, as well as the simplicity and speed, are particular advantages of this method. (J.S.R.)

27137 THE EXTRACTION OF PERRHENATES BY KETONES. D. I. Ryabchikov, Yu. B. Gerlit, A. V. Karyakin, V. A. Zarinskii, and M. E. Zubrilina (V. I. Vernadskii Inst. of Geochemistry and Analytical Chemistry, USSR). Doklady Akad. Nauk S.S.S.R., 144: 585-7(May 21, 1962). (In Russian)

Re(VII) and Tc(VII) are extracted by various ketones if the ratio 28: mol wt is taken as a parameter for the extraction of Re(VII) and Tc(VII) by various ketones (28 is the molecular weight of the CO-group and mol wt is the molecular weight of the ketone). It was found that the distribution coefficient α for the extraction of Re(VII) or Tc(VII) into the organic solvent increases linearly with the ratio 28: mol wt of the ketone. The "thermodynamic" distribution coefficient α decreases with increasing temperature. A plot of $\lg \alpha$ versus $1/T$ is linear, and the slope of this plot gives the total heat of extraction. With methylethylketone the value of α is 120, and the value of $-\Delta H$ in kcal is 7.1 ± 0.2. For cydohexanol, α is 68, and $-\Delta H$ is 6.6 ± 0.2, while the value of α is 3.2 for diethylketone and $-\Delta H$ is 2.2 ± 0.2 kcal. A comparison of all the data obtained by infrared spectroscopy indicates that rhenium is bound directly to the ketone. (TTT)

27138 THE EXTRACTION OF TECHNETIUM IN THE FORM OF TRIPHENYLGUANIDINE PERTECHNETATE. A. A. Posdnyakov, N. N. Basargin, and Yu. B. Gerlit (V. I. Vernadskii Inst. of Geochemistry and Analytical Chemistry, USSR). Doklady Akad. Nauk S.S.S.R., 144: 861-3(June 1, 1962). (In Russian)

Technetium was separated from ruthenium and molybdenum with the use of triphenylguanidine (TΦG) as an extractant in β,β-dichlorodiethyl ether as a diluent. It was found that the extraction coefficient for Tc was much higher from a H_2SO_4 solution than from HNO_3, HCl or $HClO_4$ solutions. Tc^{99m} (half life = 6.0 hr), Mo^{99} (half life = 2.8 days), and Ru^{106} (half life = 290 days) were used as tracers. In zero to 10 M H_2SO_4, the extraction of Ru^{+3}, Ru^{+4} or the ruthenium nitrosyl complex was very low, while extraction coefficients for TcO_4^- and ReO_4^- lay in the range of 100 to 1000. The extraction coefficient for molybdate was about one. The decontamination from ruthenium was rapid and effective, as shown by the purity of Tc^{99m} isolated from a mixture of Tc^{99m} and Ru^{106} activities. (TTT)

27139 CHROMATOGRAPHIC SEPARATION OF RARE EARTHS BY MEANS OF PAPER TREATED WITH THE

LIQUID CATION EXCHANGER DI-(2-ETHYLHEXYL) ORTHOPHOSPHORIC ACID. E. Cerrai and C. Testa (CISE, Milan). J. Chromatog., 8: 232-44(June 1962). (In English)

The chromatographic behavior of rare earths on paper treated with di-(2-ethylhexyl) phosphoric acid (HDEHP) was investigated. The quantity log $(1/R_F - 1)$ was related to: the atomic number of the element, the molarity of the acid used as eluent, the molarity of the solution with which the paper is treated, and the operating temperatures. Under the same conditions, the R_F values increase as the atomic number decreases; furthermore, for a given element, R_F increases with the molarity of the eluting acid (HCl), with the operating temperature and, finally, it decreases with the concentration of HDEHP on the paper. Some examples are given of the chromatographic separation of rare earths from each other and from Y, Sc, Th, U, Fe, Al, and Zr. In addition to paper treated with HDEHP alone, strips were investigated on which tri-n-octylamine (TNOA) was fixed on a small part of the surface, and HDEHP on the remaining surface. The possibility of separating large amounts of rare earths by means of columns filled with HDEHP-treated cellulose powder or with mixed beds is anticipated. (auth)

27140 PAPER CHROMATOGRAPHY OF THE LANTHANIDES. Maria Odette Maia and R. A. Guedes de Carvalho (Centro de Estudos de Quimica Nuclear, Porto, Portugal). J. Chromatog., 8: 245-60(June 1962). (In French)

A systematic study was made of the R_F values of the lanthanides, Sc, Y, Th, Zr, and U, with HCl + H_2O + alcohols as eluants. The influence of the presence of various chlorides in the eluant was also studied. An attempt was made to interpret some of the facts observed. (auth)

27141 ION-EXCHANGE CHARACTERISTICS OF THE RADIUM–ETHYLENEDIAMINETETRAACETATE COMPLEX. L. Baetslé and E. Bengsch (Centre d'Études Nucléaires, Mol, Belgium). J. Chromatog., 8: 265-73 (June 1962). (In English)

The stability constant of Ra^{226}-EDTA was determined using the method of Schubert in a modified form. The constant was found to be such that log K = 7.07 ± 0.06. The influence of the Na^+ and acetate ions in the solutions was taken into account by applying appropriate corrections. An equation was developed giving the relationship between the distribution coefficients in free and complexed solutions. The formulas provide the basic data for the design of a decontamination assembly for Ra^{226} in EDTA solutions with ion-exchange columns. (auth)

27142 THE ADSORPTION OF EUROPIUM AND CERIUM ON A STRONG BASE ANION EXCHANGE RESIN FROM DILUTE NITRIC ACID SOLUTIONS CONTAINING ALIPHATIC ALCOHOLS. R. A. Edge (Univ. of Cape Town, Rondebosch, South Africa). J. Chromatog., 8: 419-21 (July 1962). (In English)

The adsorption of europium and cerium tracers on Dowex-1 from dilute HNO_3 solutions containing different alcohols of the aliphatic series is described. From radiometric analysis of the liquid phase before and after equilibration, the percentage rare earth activity adsorbed by the resin was computed. The adsorption of the rare earths on the resin increased with increasing alcohol concentration. With the exception of adsorption of Eu from methanol, the rare earth adsorption from nitric acid–aliphatic alcohol solutions decreased with increasing length of the primary carbon chain in the alcohols concerned. At constant alcohol concentrations, cerium was adsorbed more readily than europium. (M.C.G.)

27143 LABORATORY-SCALE DEMONSTRATION OF THE FUSED SALT VOLATILITY PROCESS. G. I. Cathers, R. L. Jolley, and E. C. Moncrief (Oak Ridge National Lab., Tenn.). Nuclear sci. and Eng., 13: 391-7(Aug. 1962). (ORNL-TM-80)

The feasibility of processing enriched irradiated zirconium–uranium alloy fuel by the fused salt-fluoride volatility procedure has been demonstrated in laboratory tests with fuel having a burnup of over 10%. Uranium recoveries were greater than 99% and decontamination factors for radioactive fission products were 10^8 to 10^9. The UF_6 product contained significant quantities of nonradioactive impurities; additional work in this area is needed. (auth)

27144 MECHANISM OF Zr EXTRACTION BY PHOSPHOORGANIC COMPOUNDS. [PART] I. G. P. Nikitina and M. F. Pushlenkov. Radiokhimiya, 4: 137-47(1962). (In Russian)

The behavior of Zr in extraction from nitric acid solutions by $(C_4H_9O)_3PO$, $(C_4H_9O)_2C_4H_9PO$, and $C_4H_9O(C_4H_9)_2PO$ was studied, and Zr distribution constants were found as well as the constants of zirconium nitrate complex formation in aqueous solutions. (R.V.J.)

27145 EXTRACTION OF Th FROM VARIOUS ELEMENTS BY LABELED ATOM METHOD. II. BEHAVIOR OF RARE EARTHS IN EXTRACTION OF THORIUM PHENYL ACETATE SEPARATION OF THORIUM FROM COMPLEX COMPOUNDS. I. A. Tserkovnitskaya and A. K. Charykov. Radiokhimiya, 4: 184-8(1962). (In Russian)

Solvent extraction of Th (as thorium phenylacetate) from rare earths by diethyl ether was studied, and the effects of Al, Ca, Fe, Mg, Pb, rare earths, and other elements on the extraction are analyzed. (R.V.J.)

27146 SEPARATION OF Np^{4+}, Pu^{4+}, AND Am^{3+} FROM SOLUTIONS BY SULFATE METHOD. V. I. Grebenshchikova and N. B. Chernyavskaya. Radiokhimiya, 4: 232-4 (1962). (In Russian)

Distribution coefficients for Np^{4+}, Pu^{4+}, and Am^{3+} in potassium sulfate were determined, and it was found that quantitative amounts of Pu could be separated from unsaturated potassium sulfate solutions. (R.V.J.)

27147 SEPARATION OF CERIUM FROM OTHER RARE-EARTH METALS. A. N. Zelikman and Z. M. Lyapina. Tsvetnye Metally, No. 1, 115-20(1962).

Separation of Ce from other rare-earth metals by oxidation of Ce^{3+} to Ce^{4+} in an aqueous suspension of rare-earth metal hydroxides with oxygen under pressure at an elevated temperature was investigated. The hydroxides were obtained from a solution of chlorides containing 29.5% rare-earth metals, either directly by precipitation with caustic soda or ammonia or indirectly by converting the chlorides to double sulfates and by decomposition of the latter with caustic soda. The experimentally determined optimum conditions were: pH = 10; oxygen pressure, 5 to 10 atm; and temperature, 130°C. Under these conditions, complete oxidation of Ce occurs in 30 min, but only in the hydroxides obtained by decomposition of sulfates. Oxidation of Ce in hydroxides precipitated from chloride solutions by ammonia is incomplete. Oxygen-treated rare-earth metal hydroxides yield cerium concentrates with up to 95% CeO_2. (auth)

27148 FRACTIONAL CRYSTALLIZATION OF DYDIMA IN THE FORM OF DOUBLE NITRATES. Yu. S. Sklyarenko and Yang-yu Liang. Zhur. Priklad. Khim., 35: 1016-21 (May 1962). (In Russian)

Two variations in the fractional crystallization of

cerium-group elements enriched by neodymium and praseodymium are compared. It is shown that neodymium separation with ammonium nitrates is more efficient than with magnesium nitrates. It is also shown that an effective separation of Nd and Pr can be achieved by fractional crystallization. (R.V.J.)

27149 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF URANIUM VALUES. Anthony George Hamlin and Benjamin Joseph Roberts (to United Kingdom Atomic Energy Authority). British Patent 900,113. July 4, 1962.

A method is given for separating U values from impurities. The method comprises feeding an acidified aqueous solution of the U values and impurities to a lyophic organic polymer column supporting an organic solvent which retains U at the top of the column, washing the column with acid to remove impurities, and eluting U from the column with water. A suitable column material is poly(trifluorochloroethylene), preferably the low-density molding powder KEL-F-300, and the organic solvent may be tributyl phosphate. (D.L.C.)

27150 PROCESS OF REMOVING THE METALLIC CASINGS OF FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Gebr. Bohler and Co.). British Patent 900,157. July 4, 1962.

A process for removing the casings of reactor fuel elements is described which enables weak solvents to be used and economical materials to be used for the tanks. The process comprises applying an electric current with the immersed fuel element as the anode. Thus, the dissolution speed of a commercial steel in 40% HNO_3 at 40°C may be increased from 0.01 to 3600 g/m^2-hr by a current density of 0.6 amp/cm^2. The removal speed of steel casings may be increased further by annealing the casings prior to their removal. (D.L.C.)

27151 IMPROVEMENTS IN OR RELATING TO SOLVENT EXTRACTION PROCESSES. Alfred Gavin Maddock and Anthony George Goble (to United Kingdom Atomic Energy Authority). British Patent 902,337. Aug. 1, 1962.

A process was developed for extracting complex metal anions from an acidic aqueous solution by contacting it with a mixture consisting of a primary or secondary alcohol and a liquid which is substantially insoluble in water and with a higher dielectric constant than the alcohol. The alcohol should have a sufficient number of carbon atoms in its molecule to make it substantially insoluble in water. Eight examples are given for this process. The extractive power of the alcohol is increased by the use of a diluent with higher dielectric constants. (M.C.G.)

27152 SEPARATION OF PLUTONIUM. (to United Kingdom Atomic Energy Authority). British Patent 902,741. Aug. 9, 1962.

A process is outlined for separating Pu, e.g., from irradiated U. The process involves the usual formation of a LaF_3 precipitate carrier under reducing conditions, except that the hydrogen ion concentration is adjusted to a value approaching neutrality to improve the characteristics of the precipitate. (D.L.C.)

27153 SOLVENT EXTRACTION PROCESS FOR SEPARATING URANIUM AND PLUTONIUM FROM AQUEOUS ACIDIC SOLUTIONS OF NEUTRON IRRADIATED URANIUM. F. R. Bruce (to U. S. Atomic Energy Commission). U. S. Patent 3,046,087. July 24, 1962.

A solvent extraction process was developed for separating actinide elements including plutonium and uranium from fission products. By this method the ion content of the acidic aqueous solution is adjusted so that it contains more equivalents of total metal ions than equivalents of nitrate ions. Under these conditions the extractability of fission products is greatly decreased. (AEC)

27154 PROTACTINIUM EXTRACTION. F. L. Horn (to U. S. Atomic Energy Commission). U. S. Patent 3,046,088. July 24, 1962.

A method of producing and separating protactinium from thorium containing solids is described. The protactinium is formed by irradiating thorium containing solids, such as thorium dioxide and thorium tetrafluoride with neutrons. The protactinium is separated from the thorium solids by contacting the solids with a non-aqueous solution of hydrogen fluoride and a complexing agent, NO_2. The protactinium complex formed is soluble in the non-aqueous solution, whereas the thorium solids remain insoluble in the solution. (AEC)

27155 PROCESS FOR PRECIPITATING READILY FILTERABLE RARE EARTH HYDROXIDES. Pawel Krumholz. U. S. Patent 3,049,403. Aug. 14, 1962.

An improved process for separating rare earths by precipitating their hydroxides at low temperatures is given which increases the oxide content of the precipitates from 25 up to 50% and the filtration rate by a factor of 10 to 100. The process comprises carrying out the precipitation at 25 to 50°C with a solution of alkali or ammonium hydroxide and an aliphatic carboxylic acid of low molecular weight. The acid may be formic acid, acetic acid, or propionic acid in a concentration of 5 to 15% of the hydroxide normality, and the addition of the acid need only be made in the precipitation of the first 20 to 25% of the rare earth mixture. (D.L.C.)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstract 28383.

27156 (AD-269792) SOVIET NUCLEAR INSTRUMENTATION AND CONTROL FOR PROPULSION. AID Work Assignment No. 16c. Monthly Report No. 9, September 10, 1961 to November 10, 1961. (Library of Congress. Aerospace Information Div., Washington, D. C.). Dec. 11, 1961. 18p. (AID-Report-61-152).

Reports of developments are presented concerning a differential method for determining the efficiency of a gamma counter, a fast neutron scintillation counter with low gamma sensitivity, a pneumatic integrator with an aperiodic unit throttle operating in low pressure range, a balancing-flow gas meter, a study of interaction between two subcritical reactors, investigation of spent nuclear fuel elements, and an investigation of heat transfer in turbulent flow of metals in pipes. (J.R.D.)

27157 (AERE-R-3976) A CONCRETE CELL FOR THE ANALYSIS OF MULTI-CURIE ALPHA, BETA, GAMMA ACTIVE MATERIALS. A. J. Wood and A. J. Fudge (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1962. 24p.

A concrete cell was adapted for the purpose of the analysis of material with up to 1000 Mev curies of β, γ activity, with associated high levels of α activity. Details are given of the construction of the cell and of the installed equipment together with descriptions of the techniques and apparatus used for the analysis of irradiated nuclear fuel specimens. (auth)

27158 (DP-703) DECONTAMINATION OF REACTOR HEAT EXCHANGERS—SAVANNAH RIVER PLANT. C. A. Meyer (Du Pont de Nemours (E. I.) & Co., Wilmington, Del.). May 1962. Contract AT(07-2)-1. 28p.

A program of decontamination of reactor heat exchangers built of type 304 stainless steel has been undertaken at the Savannah River Plant to expedite repairs on the heat exchangers. The bases for the selection of a decontaminating agent, the equipment and procedures used for decontamination, and the results of the operation are given in this report. Decontamination of the heat exchangers has been successfully carried out to the desired result, which was the reduction of radiation levels to permit an eight-hour work day on the heat exchanger tube sheets. (auth)

27159 (DP-724) CONTAINMENT BOX FOR RADIOACTIVE MATERIALS. Albert E. Symonds and W. Harold Leith (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). July 1962. Contract AT(07-2)-1. 10p.

A general purpose glove box was developed that combines corrosion resistance with lightness, economy, and ease of fabrication. The box is made from a fire-resistant, self-extinguishing polyester resin reinforced with glass fibers. (auth)

27160 (HW-74194) THE USE OF CELLOSOLVE IN NaK DISPOSAL. C. G. McCormack (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. Contract AT(45-1)-1350. 5p.

A cellosolve-kerosene system and the protection of liquid nitrogen as a fire extinguisher reduced the opening of irradiated NaK-containing capsules to a virtually routine status. Cellosolve, or ethylene glycol monoethyl ether, is a clear liquid, slightly more dense than kerosene. The specific gravity is 0.93 at 20°C, and the flash point is 44°C. Cellosolve may be poured directly into a container of kerosene and NaK. (C.H.)

27161 (NYO-9810) ULTRAHIGH VACUUM TECHNIQUES. Quarterly Progress Report, January 1–March 31, 1962. Research Report 62-808-441-R3. (Westinghouse Electric Corp. Research Labs., Pittsburgh). May 2, 1962. Contract AT(30-1)-2823. 10p.

Further experiments with the zeolite traps using both "nude" and tubulated ion gages indicates an appreciable amount of untrapped vapors passing through the unrefrigerated zeolite. The exact nature of this vapor was not determined. Investigations of the all stainless steel vacuum system indicate that the large source of desorbed H_2 is that adsorbed in the walls. Other work is reported on low-temperature cathodes and construction of an ionization gage incorporating a SiC emitter and an electron multiplier. A system to give semi-quantitative data on the solution of H_2 in W, as a function of temperature, was assembled and is being tested. (J.R.D.)

27162 (TID-16105) THE APPLICATION OF GAS-LUBRICATED BEARINGS TO HIGH-SPEED TURBOMACHINERY. Quarterly Technical Report, December 1, 1961 to February 28, 1962. M. W. Eusepi, A. Marmarou, and D. D. Fuller (Franklin Inst. Labs. for Research and Development, Philadelphia). Contract AT(30-1)-2512. 35p. (Q-A2392-3-4)

Several advances were made in both the instrumentation and experimental testing required on the program. The final results are presented of instrumentation work, calibration, the modified instrument circuits, and a noise level evaluation. Also reported are results of experiments performed on the EP-2 rig (externally-pressured bearings) including rotational testing up to a speed of 9000 rpm. Significant results were also obtained on the operational testing of the SA-2 rig (self-acting bearings). The rig was completely de-bugged and the first rotational tests made. At the close of the report period a speed of 20,180 rpm was reached. (auth)

27163 (TID-16358) THE BEARING SEAL. A Design Evaluation. William K. Stair (Tennessee. Univ., Knoxville. Engineering Experiment Station). Apr. 1962. For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26], Subcontract 2118. 30p. (ME-5-62-TN-2)

A survey and review is presented of technical literature dealing with the problems of dynamic sealing. The investigation is directed toward the theoretical and experimental analysis of devices suitable for use as dynamic seals for gases. The buffered bushing seal and the buffered labyrinth seal involve rather extensive auxiliary systems when these seals are used in conjunction with a gas-cooled nuclear reactor. A suggestion has been made that the systems may be considerably simplified if a single functional unit, the seal-bearing, could be arranged to serve the function of a bearing and as a seal. This report is aimed at finding a suitable basis of design for such a combined unit and identifying problem areas which require further study or development. Other dynamic seals being studied included mechanical face seals, buffered bushing seals, visco seals, and labyrinth seals. (auth)

27164 (IG-Inf-Ser-9) RESEARCH RESULTS ON SURGES AT SWITCH-OFF IN HIGH-VOLTAGE MOTORS. M. P. Fourmarier. Translated by R. Presser (U.K.A.E.A. Industrial Group H. Q., Risley, Lancs, England) from Bull. sci. A. I. M. (Belg.), No. 12, 745-75(Dec. 1956). 26p.

The results are presented along with discussion of the overall phenomena which can occur during switch-off with respect to both surges and restrikes. Information is included on experimental results obtained at testing stations using various types of curcuit-breakers. A summary of new experiments on switching-on is also included with conclusions. (J.R.D.)

27165 (NP-tr-891) RECENT DEVELOPMENTS IN HIGH PRESSURE TECHNIQUES. Jacques Basset. Translated by R. H. Michael (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Atomes (Paris), 11: 363-8(Dec. 1956). 25p. (Includes original, 5p.).

A review of developments is presented which includes discussions of high-pressure use in industry, and in fabrication and use of ordnance materiel. Also included is a description concerning generators capable of producing pressures above 1000 atm. Other sections are on sealing, hydraulic intensifiers, and isodynamic compressors. (J.R.D.)

27166 THE "2kC" ^{60}Co RADIATION UNIT OF THE BORIS KIDRICH INSTITUTE AT VINCHA. B. B. Radak and I. G. Draganić. Bull. Inst. Nuclear Sci. "Boris Kidrich" (Belgrade), 13: No. 1, 77-88(Apr. 1962). (In English)

A general description of the "2kC" Co^{60} radiation unit at Vincha with its components such as the source, container, driving mechanism, radiation room, remote control table, etc., is given. The results of dosimetric topography are shown, and the irradiation and technical possibilities of this equipment are presented. (auth)

27167 A PULSE MAGNETOGASDYNAMIC A-C GENERATOR FOR DIRECT CONVERSION OF KINETIC INTO ELECTRIC ENERGY. P. V. Kachanov and Ye. I. Yantovskii. Byull. Izobret., No. 23, (Dec. 1961).

A pulse magnetogasdynamic a-c generator was designed for the direct conversion of kinetic into electrical energy. Its magnetic system is in the form of a core placed coaxially with an external cylindrical magnetic circuit, both carrying cylindrical windings. To reduce the operating temperature of the gas, a d-c winding is placed on the core. This excites electrodeless loop discharges in the gas flow, inducing an a-c pulse emf in the operating windings. (OTS)

27168 SOLID-STATE PULSER DRIVES CHEMICAL PUMP. U. L. Upson (General Electric Co., Richland, Wash.). Electronics, 33: No. 49, 74: 76(Dec. 2, 1960). (HW-SA-1947)

Development of an all-solid-state pulse generator employing controlled rectifiers as power switching units is described. The device delivers d-c pulses of up to 5 amps alternately to 2 equal loads, at rates variable from about $1\frac{1}{2}$ to 25 cycles/sec. (J.R.D.)

27169 SUPERCONDUCTING SOLENOIDS. R. W. Boom and R. S. Livingston (Oak Ridge National Lab., Tenn.). Proc. IRE (Inst. Radio Engrs.), 50: 274-85(Mar. 1962).

A method for approximate optimization of superconducting solenoids based on an extension of the classical Fabry formulation is presented. Graphs of pertinent parameters were prepared for the regions of interest for superconductors. Several sample calculations illustrate the differences in design factors as compared with conventional magnets. (auth)

27170 WHAT HAVE YOU PROVED? W. E. Boyes (Sandia Corp., Albuquerque, N. Mex.). p.103-28 of "Symposium-Electronic Systems Reliability, Kansas City, Missouri, November 14, 1961." (SCR-464)

A discussion is presented on reliability engineering from the standpoint of nuclear weapons manufacture. It is emphasized that part tests are quality tests but not reliability tests, which gives the probability of success in use. Some observations on quality control and reliability are given. Testing of assemblies is discussed with comments on accelerated life tests. (D.L.C.)

27171 DOUBLE GLAZED PRISMATIC WINDOW. (to Corning Glass Works). British Patent 899,516. Aug. 1, 1962.

Double glazed windows for viewing the interior of a radiation chamber were developed for increasing the visible area of the chamber. The window consists of two transparent sheets of material spaced from one another with their borders bridged by a bellows, and the space between them filled with a high refractive index fluid. One plane is placed in fixed register with the normal chamber window in face-to-face relation therewith and immediately adjacent to it. The other plane is hung in gimbals. This plane can thus be turned in any direction to give the window a prismatic form that bends the rays of light entering the chamber from 0 to 18° or more to increase the visible area. (M.C.G.)

27172 IMPROVEMENTS IN OR RELATING TO THE DETECTION OF FISSION PRODUCTS. Murray Vincent Wilson (to Plessey Co. Ltd.). British Patent 900,247. July 4, 1962.

An apparatus for detecting fission products in a first fluid carrier (water) is designed which effects transfer of the fission products to a gas carrier and thence to a second fluid carrier for counting. In the apparatus, the contaminated water is caused to percolate through a porous plate into contact with a gas stream moving parallel with the plate. The fission products Kr and Xe charged into the gas decay to form Rb and Cs which are caused by an electrostatic field to move toward a second plate to be carried away by pure water for counting. The apparatus may be used in a continuous or intermittent manner to monitor coolant from water-cooled reactors. (D.L.C.)

27173 TUBE SPLITTING APPARATUS. (to U. S. Atomic Energy Commission). British Patent 900,500. July 4, 1962.

A tube splitter is designed for facilitating removal of a tube from a mass of material in which it is lodged, e.g., a damaged coolant tube in a reactor. The tube splitter is to be pulled through the tube by a cable connected with a device described in British Patent 900,501. (D.L.C.)

27174 A CONNECTING DEVICE FOR TOOL AND CABLE. (to U. S. Atomic Energy Commission). British Patent 900,501. July 4, 1962.

A device is designed for connecting a tool with a cable for pulling the tool through a tube without rotating the tool. The device is to be used with the tube-splitting tool described in British Patent 900,500. (D.L.C.)

27175 IMPROVEMENTS IN OR RELATING TO THE INTERNAL ILLUMINATION OF OPAQUE PRESSURE VESSELS. John Malyon Waldram (to General Electric Co. Ltd.). British Patent 901,027. July 11, 1962.

An arrangement for permitting transmission of light to the interior of a pressure vessel, e.g., for servicing a re-

ator, is described which reduces the required aperture size. The arrangement comprises a polished, fused silica cylinder held in the aperture by an abutment and a flange. The cylinder length is such that a cone of light of sufficient vertex angle incident on the outer end face is totally internally reflected out the curved surface. A prismatic plate lens may be placed a short distance from the inner end face. (D.L.C.)

27176 IMPROVEMENTS IN OR RELATING TO HIGH-ACTIVITY CELLS. (to Commissariat à l'Énergie Atomique). British Patent 901,137. July 18, 1962.

A process was developed for limiting opacification of a glass slab subject to radiation as the window of a hot cell. The method takes advantage of the property of auto-regeneration of the optical qualities of the glass by alternate exposure of first one and then the other face of a block of glass to the zone of maximum radiation intensity. According to this process, different layers of the glass are located in zones where alternatively they receive radiation respectively higher and lower than the intensity I_s, the discoloration threshold, in such a manner that neither of the layers receives, during an interval of time t, an integral dose higher than $\int_0^t I_s dt$. This is effected by constituting the internal part of the window by a slab of glass which can pivot about a horizontal or vertical axis to present successively to the zone of intense radiation, one or the other of its faces. (M.C.G.)

27177 IMPROVEMENTS IN OR RELATING TO D.C. AMPLIFIERS. Eliot Patrick Fowler (to United Kingdom Atomic Energy Authority). British Patent 902,679. Aug. 9, 1962.

A d-c amplifier for a voltage converter is designed which is stable against temperature changes. The amplifier comprises means for modulating a d-c input signal, an a-c amplifier for the modulated input signal, means for applying the a-c output of the amplifier to drive the modulating means so that the circuit oscillates for a given polarity of input only, and non-phase-sensitive rectifying means for producing a d-c output from the a-c output. A transistor circuit embodying the amplifier and for converting a 40 v input supply to a stable 400 v output is described in detail. (D.L.C.)

27178 IMPROVEMENTS IN FLUID FILM DYNAMIC BEARING-SYSTEMS. Fernand Bourquard (to Commissariat à l'Énergie Atomique). British Patent 903,055. Aug. 9, 1962.

A gaseous film dynamic bearing system is designed with means for reducing the leaks at the end portions. The means comprise annular recesses on the inner wall of the bearing element within the leak sector, the recesses forming two or more partitioned grooves at each end. The pressure in the region of these grooves is higher than that for uninterrupted circular grooves of the conventional type, making it unnecessary to increase the length of the bearing element for a given load of the rotating shaft. (D.L.C.)

27179 IMPROVEMENTS IN OR RELATING TO LIQUID-LIQUID CONTACTING APPARATUS. Donald Hebden and Kenneth Hartley (to United Kingdom Atomic Energy Authority). British Patent 903,640. Aug. 15, 1962.

A pulsed mixer-settler of the kind described in British Patent 831,383 is designed with a contamination barrier. In the mixer-settler, air pulses are used to suck liquid from the mixer compartments into mixer tubes and to re-inject the liquid into the compartments, and water spray is fed into the columns transmitting the air pulses to present a barrier to contaminants. (D.L.C.)

27180 IMPROVEMENTS RELATING TO A DISTRIBUTION DEVICE SERVED BY HOISTING MEANS. (to Société des Forges & Ateliers du Creusot). French Patent 1,230,547. Sept. 16, 1960.

A distribution device is described that comprises several vertical ducts that give passage to elements handled by a winch, so that these elements may temporarily be stocked in the ducts while the winch is being used for handling other things (e.g., another element). Preferably these vertical ducts constitute cells of a rotatable magazine and may be brought successively into alignment with the path of the winch, which is preferably positioned above the magazine. In order to fix an element in a cell, a floor plate pivotally mounted on the cell wall is turned into horizontal position so that it forms a support, on which a shoulder of the element to be stocked can rest. Each cell is provided with a drive gear for the control of movement of the floor plate. This gear is coupled, in the position of alignment of cell and winch, with a driving axle mounted in the casing structure in which the magazine is placed. (NPO)

27181 PARTICLE ACCELERATORS. Ilia Podliasky (to Commissariat à l'Énergie Atomique). U. S. Patent 3,043,986. July 10, 1962.

An accelerating drift tube arrangement is designed for use in particle accelerators of the proton synchrotron type. The arrangement comprises a drift tube, a casing surrounding the drift tube, two tubular elements coaxial with the tube, and variable self-inductance means interposed between the tube and the casing wall. The arrangement forms an oscillatory circuit and prevents an uncontrollable phase difference from developing. (D.L.C.)

27182 RADIATION SHIELDING WINDOW. Carl H. Ohrn (to Research Equipment Co.). U. S. Patent 3,045,120. July 17, 1962.

A radiation shielding window comprising a solution of $ZnBr_2$ or some other zinc halide between two spaced glass sheets is designed which can be assembled readily and is resistant to discoloration due to $ZnBr_2$ attack on steel. The sides and bottom of the window are formed with a copper liner rather than steel, and the window has a chamber for expansion of the $ZnBr_2$ solution. (D.L.C.)

27183 X-RAY PROTECTIVE SHIELDS. Charles W. Leguillon. U. S. Patent 3,045,121. July 17, 1962.

A flexible x-ray shielding material is described which has no tendency to develop cracks along its surface when irradiated. The material comprises a relatively thick lead-impregnated barrier portion surrounded by a thin high-skin-strength surface portion. The barrier portion preferably is finely flaked lead dispersed in a plastic or rubber, and the surface portion is a high-carbon-black rubber stock containing 4 to 8 parts of an antiozonant. The material is suitable for making into protective gloves and aprons. (D.L.C.)

27184 DEVICE FOR THE STORAGE OF A HEAT EVOLVING MATERIAL. Donald W. Montgomery (to Babcock and Wilcox Co.). U. S. Patent 3,046,403. July 24, 1962.

A storage and shipping shielded cask is designed for spent reactor fuel. The cask comprises a cylindrical steel vessel embedded in a rectangular cask of radiation shielding material, an exterior heat exchanger, and means for circulating water from the vessel containing the fuel elements to the heat exchanger for cooling by air. (D.L.C.)

27185 ISOTOPE X-RAY. Donald T. Green (to Picker X-Ray Corp., Waite Mfg. Div., Inc.). U. S. Patent 3,046,430. July 24, 1962.

A self-energized, portable x-ray tube is designed which uses beta-emitting material. The tube comprises a tear-shaped housing with a beta source at one end, an x-ray-producing target (e.g., tungsten) at the opposite end, and electrostatically charged rings for focusing the beta beam onto the target. A shutter is provided for turning the beta beam on and off. (D.L.C.)

27186 X-RAY SHUTTER APPARATUS. Harry E. Koerner and Everett W. Vaughn (Westinghouse Electric Corp.). U. S. Patent 3,048,700. Aug. 7, 1962.

An improved x-ray shutter apparatus for radiology is designed which is adjustable bidirectionally by only one control member and which has means for indicating the aperture size and shape. (D.L.C.)

27187 RADIOACTIVE SOURCE HOLDER. Eugene P. Thomas (to Westinghouse Electric Corp.). U. S. Patent 3,048,701. Aug. 7, 1962.

An improved radiation source holder is designed for radiotherapy, particularly with a Co^{60} source. The holder has improved means for actuating the source between the repose and active positions and for shielding the guideway along which the source is moved. A fluid pressure-actuated piston assembly is mounted in the guideway for moving the source, and spring means is provided for returning the source to its fully shielded position in case of fluid pressure failure. (D.L.C.)

Heat Transfer and Fluid Flow

Refer also to abstracts 28377, 28381, 28419, 28429, and 28557.

27188 (62GL54) COLLECTION OF HEAT-TRANSFER PROPERTIES OF GASES AT MODERATE PRESSURES AND RULES FOR RAPID ESTIMATION OF MISSING DATA. F. J. Neugebauer (General Electric Co. General Engineering Lab., Schenectady, N. Y.). Apr. 30, 1962. Contract Nonr-3804(00). 219p.

Data are given on molecular heat capacity, viscosity, thermal conductivity, and Prandtl number for 380 gases and 84 elements and compounds considered as gases. Heat transfer properties of gas mixtures are also given. It is concluded that it is possible to rapidly estimate specific heat, viscosity, and thermal conductivity of gases and constants needed for the prediction of mixture properties if only the empirical chemical formulas of the gases are known. The method allows a broad survey over the entire field of available gases. (P.C.H.)

27189 (AD-270678) INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER. Quarterly Progress Report No. 1. Richard E. Balzhiser, John A. Clark, C. Phillip Colver, Edward E. Hucke, Thomas McSweeney, Herman Merte, Jr., and Lowell R. Smith (Michigan. Univ., Ann Arbor. Coll. of Engineering). Jan. 1962. Contract AF 33(616)-8277. 36p.

An analytical and experimental study relating to the boiling of liquid metals were initiated. The program will include pool boiling studies of K, Na, and Rb at temperatures up to 2200°F. Hg will be pool boiled at temperatures near its normal boiling point as a preliminary step in studying the effect of radial accelerations up to 20 times normal gravity on the boiling process. A forced circulation loop is being designed to determine the effect of velocity and quality on the heat transfer process. Two-phase flow studies will also be made with this equipment. (auth)

27190 (AFOSR-TR-59-84) SOME DETAILS OF THE TRANSITION TO TURBULENT FLOW IN POISEUILLE FLOW IN A TUBE. A. M. Kuethe and K. R. Raman (Michigan. Univ., Ann Arbor). June 1959. Contract AF18(603)-34. 37p. (AD-232746)

Measurements of velocity fluctuations, Reynolds stresses, and shearing stresses at the wall in the transition region of a tube are presented. The measurements were made in a tube at a Reynolds number of 6000 behind 3 disturbance generators placed in the fully developed laminar flow 620 diameters from the entrance. The results show the way in which some of the statistical details of the transition depend on the nature of the disturbance generated. The Reynolds stresses and the shearing stress at the wall can reach very high values during the early stages of transition. Implications are pointed out regarding possible causes for the high temperature recovery factor during transition in high speed flow over surfaces. (auth)

27191 (CEA-2122) ETUDE DE L'AMELIORATION DES ECHANGES DE CHALEUR DANS LES GAZ AU MOYEN DE CHAMPS ELECTRIQUES. (Improvement of Heat Transfer to Gases by Mean of Electric Fields). (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1962. 47p.

The effects of electric fields on heat transfer to the following gases: air, argon, nitrogen, carbon dioxide, helium, and hydrogen, were studied in an annular channel, the inner part of which is the heating element. Experiments were made both in free convection and forced convection, the latter case with and without an external source of ionization. Two causes of improvement of heat transfer were found: electroconvection and ionic convection; the influence of various parameters (electric fields, current of ionization, temperatures, pressures, and flow rate) is also investigated. Increasing of exchanged power was measured: in free convection the increasing reached 400% and, in forced convection, it was found to be mainly dependent on stream velocity, decreasing from 300% at Re = 6000 to few per cent for Re ≥ 30,000 for a given gas pressure. (auth)

27192 (HW-73395) PRELIMINARY BOILING BURNOUT EXPERIMENTS WITH A 19-ROD BUNDLE GEOMETRY IN AXIAL FLOW. G. M. Hesson, D. E. Fitzsimmons, E. D. Waters, and J. M. Batch (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 17, 1962. Contract AT(45-1)-1350. 15p.

Boiling burnout heat flux data were obtained with an electrically heated model of a 19-rod bundle nuclear reactor fuel assembly in a cylindrical tube for vertical upward flow of water at 1200 psig. Heat was generated in the test section by d-c electrical resistance heating. Mass flow rates were 0.5, 1.0, 2.0, and 3.0×10^6 lb/hr-ft^2 and exit coolant qualities ranged from 0 to 29 wt % steam. The resultant data are compared with independent data for a 19-rod bundle. (auth)

27193 (TID-15969) BASIC EXPERIMENTAL STUDIES OF BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report, May 1962. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). May 31, 1962. Contract AT(30-3)-187. 11p. (MPR-XIII-5-62)

Emphasis on the test program was temporarily shifted to study the effect of helium gas dissolved in the coolant stream on the subcooled boiling burnout heat flux for a large internally heated annulus. A new test section capable of achieving heat fluxes in excess of 2.5×10^6 Btu/hr-ft^2 was installed in the loop. Systems for injecting helium gas and measuring the gas content of the water going to the test were also designed and fabricated. Experimental testing will begin early in June 1962. All the available two phase

pressure drop data for high heat flux 19-rod test sections were analyzed, and it was shown that a simple plot of total pressure drop versus average steam quality at constant mass velocities might be more useful than the more complex Martinelli-Nelson type analysis. (N.W.R.)

27194 (TID-16217) BASIC EXPERIMENTAL STUDIES OF BOILING FLUID FLOW AND HEAT TRANSFER AT ELEVATED PRESSURES. Monthly Progress Report, June 1962. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). June 29, 1962. Contract AT(30-3)-187. 2p. (MPR-XIII-6-62)

Test data were obtained with the Dissolved Helium Annular Test Section which was designed to study the effect on subcooled boiling burnout of helium gas dissolved in the coolant stream. The Solid Tubular Test Section is ready for final assembly. (auth)

27195 (TID-16226) PROGRESS REPORT FOR RESEARCH ON HEAT TRANSFER TO FLUIDS FLOWING THROUGH NON-CIRCULAR CHANNELS. E. R. G. Eckert and J. L. Novotny (Minnesota. Univ., Minneapolis. Heat transfer Lab.). June 1962. Contract AT(11-1)-659. 13p.

Heat transfer in rectangular ducts with two heated and two unheated walls, in a 10:1 rectangular duct with four heated walls, and in a parallel-plate duct with uniform longitudinal wall heat flux is being studied. (M.C.G.)

27196 (TID-16289) SIMULATED NUCLEAR REACTOR—VIBRATIONAL HEAT TRANSFER. Semi-Annual Progress Report, November 1, 1961–April 30, 1962. (Catholic Univ. of America, Washington, D. C.). Contract AT(30-1)-2655. 7p.

A heat transfer experiment is described in which a program of pool heating at atmospheric pressure and at vibrational frequencies at about 10 to about 90,000 cps was established as a necessary prerequisite to a pressurized, force convection, heat transfer testing program. Heaters were manufactured for pool heating tests. Coatings were developed for the heaters. Pressure tests showed no leaks in the heater assemblies. Preliminary test runs with the electrodynamic shaker showed flaws in the amplifier and shaker system instrumentation; these problems are being investigated. An accelerometer system was devised to relate the heater table movement to the heater movement so that movement of the heaters can be estimated. (J.R.D.)

27197 (UNC-5001) TWO-PHASE FLOW PATTERNS WITH HEAT ADDITION. Progress Report, September 5, 1961–December 31, 1961. (United Nuclear Corp. Development Div., White Plains, N. Y.). Jan. 15, 1962. Work performed under United States-Euratom Joint Research and Development Program. Contract AT(30-1)-2876. 18p. (EURAEC-257)

The experimental system consists of a test section with an electrically heated test strip connected to water and steam loops to provide the desired mixed flow. Coolant flow patterns near the heated strip in the test section will be observed visually and photographed through observation ports. Design of the experimental apparatus is about 65% complete. Vendors were requested to submit bids for the pumps, valves, pressurizer-separator, pressurizer heater, cooler, and high-speed motion picture camera. The designs of the test section, mixer, and electrical and controls systems remain to be completed. (auth)

27198 (UNC-5009) TWO-PHASE FLOW PATTERNS WITH HEAT ADDITION. Progress Report, January 1, 1962–March 31, 1962. (United Nuclear Corp. Development Div., White Plains, N. Y.). Apr. 15, 1962. Work performed under United States-Euratom Joint Research and Development Program. Contract AT(30-1)-2876. 23p. (EURAEC-316)

Design of the apparatus for the two-phase flow patterns experiment was completed with the exception of the test strip insulators and the instrumentation connection details. Purchase orders were placed for all the major equipment, except the cooler coil and power control package. Fabrication of the mixer and test section electrical components is about 60% complete; the loop area was cleared and structural material ordered. Insulating materials for the test section heating strip are being screened in 50-hr corrosion tests in water at 600°F. A satisfactory material has not yet been tested. (auth)

27199 (EURAEC-45) RESULTS OF WET STEAM COOLING EXPERIMENTS: PRESSURE DROP, HEAT TRANSFER, AND BURNOUT MEASUREMENTS IN ANNULAR TUBES WITH INTERNAL AND BILATERAL HEATING. Special Report No. 5. N. Adorni, S. Bertoletti, J. Lesage, C. Lombardi, G. Peterlongo, G. Soldaini, F. J. Weckermann, and R. Zavattarelli (Centro Informazioni Studi Esperienze, Milan). Jan. 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 002-59-11RDI. 64p. Translation of CISE-R-31.

Heat transfer data are presented on internally and bilaterally heated annular test elements. Data obtained using wet steam are given for pressure drop with zero power, pressure drop with power, heat transfer coefficients, and burnout heat flux. (J.R.D.)

27200 (EURAEC-106) RESEARCH ON VIBRATIONS AND HEAD LOSSES INSIDE TUBE BUNDLES. Quarterly Report No. 2, January–March 1961. P. Leon (Société Grenobloise d'Etude et d'Applications Hydrauliques, Grenoble, France). Apr. 24, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 025-60-10RDF. 5p. (A translation).

Vibration frequencies for tubes and rods subjected to an elastic distortion by applying a constant force at right angle to the tube center line and suddenly removing the force are presented. The elements are tested with both ends fixed and with one end fixed. The tube vibrations were monitored by dynamic extensometry. The stainless steel elements were tested in air. (N.W.R.)

27201 (EURAEC-288) STUDY OF VIBRATIONS AND LOAD LOSSES IN TUBULAR CLUSTERS. Special Technical Report No. 3, November and December 1961. (Société Grenobloise d'Etude et d'Applications Hydrauliques, Grenoble, France). Mar. 1962. Work performed under United States–Euratom Joint Research and Development Program. 43p. A translation.

Results obtained during an experimental study concerning vibrations of tubular elements in a flow are presented. A hydraulic model of the experiment is described, and theoretical aspects of flow perpendicular and parallel to the tube axis are discussed. Experimental results indicate that the vibrations of the tube in flow perpendicular to its axis are large in the plane perpendicular to the flow. Their amplitude is not proportionate to the flow velocity; it increases at first with the velocity, reaches a maximum, and decreases. Vibrations of a tube immersed in a flow parallel to its axis are of low amplitude under the conditions of the experiment. (J.R.D.)

27202 (FTD-TT-62-333) THE EFFECT OF A MAGNETIC FIELD ON THE FLOW OF A CONDUCTING GAS IN A PLANE TUBE IN THE PRESENCE OF HEAT

TRANSFER THROUGH THE WALLS. E. P. Zimin. Translated from Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Mekhan. i Mashinostr., No. 2, 117-19(1962).

Equations are derived for a quasi-one-dimensional stationary flow of an electrically conducting compressible gas in a tube, normal to the walls of which is applied a homogeneous magnetic field, in the presence of a heat flux through the wall. (N.W.R.)

27203 HEAT TRANSFER TO MERCURY IN PARALLEL FLOW THROUGH A BANK OF HEAVY TUBES. Aaron Judah Friedland (Columbia Univ., New York). Dissertation Abstr., 22: 3030-1(Mar. 1962).

A theoretical analysis of heat transfer to liquid metals in parallel flow through a tube bundle results in the equation $Nu = 7.0 + 3.8(P/D)^{1.62} + 0.027(P/D)^{0.27}(\phi Pe)^{0.8}$. The conditions are: fully developed turbulent flow; constant heat flux at the wall; and an equilateral triangular array of tubes. The corresponding relation for a square array of tubes is $Nu = 7.0 + 4.24(P/D)^{1.62} + 0.0275(P/D)^{0.27}(\phi Pe)^{0.8}$. The hexagonal flow area assignable to any tube in the triangular array is approximated by a circle of equal area, and the velocity distribution for an annulus is assumed to apply from the inner wall to the circle of maximum flow. Laminar-flow Nusselt numbers are also determined. Slug flow Nusselt numbers (Nu) are calculated for the actual geometry and compared with those resulting from the assumed circular boundary. Agreement within 5% is obtained for pitch-to-diameter (P/D) ratios above 1.3 with equilateral triangular tube spacing, and for pitch-to-diameter ratios above 1.7 with square spacing. Heat transfer to parallel-flowing mercury in a tube bank is also experimentally investigated. The bank consists of nineteen 0.498-inch-diameter tubular electrical heaters in an equilateral triangular array with pitch-to-diameter ratio 1.380. The heated length is 40 inches, heat flux 13,500 Btu/hr-ft^2, temperature range 120 to 260°F, and Peclet number (Pe) range 190 to 1700. Wall temperatures are measured by thermocouples imbedded in the wall of the center tube, and bulk temperatures are calculated from inlet and outlet bulk temperature measurements. The center tube is either nickel and copper plated for runs under wetted conditions, or chromium plated for runs under non-wetted conditions. No difference is found between the wetted and non-wetted results in normal operation, but the heat transfer is reduced by 30% in the non-wetted case when there is helium entrained in the mercury. A circumferential wall temperature variation is found that averages 25% of the difference between the wall and bulk temperatures. The data are scattered at the lower flows, with apparent Nusselt numbers ranging from 5 to 150. The results are more consistent at Peclet numbers above 800, falling into two groups, which tend to converge with increasing flow rates. The mean value of the Nusselt number in the Peclet number range of 800 to 1700 could be expressed as $Nu = 0.52Pe^{0.5}$ which ranges from 23% below the theoretical value at Pe = 800, to 11% below theoretical at Pe = 1700. The one-standard-deviation range is quite wide, extending from Nu = 9.6 to Nu = 16.5 at the lower limit, and remaining nearly constant at Nu = 32 at the upper limit. The spread of the data and the circumferential temperature variations are attributed to random deviations from straightness of the tubes.

27204 AN EXPERIMENTAL INVESTIGATION OF THE HEAT TRANSFER COEFFICIENTS FOR BOILING AND CONDENSING HYDROGEN FILMS. Dennis Eugene Drayer (Univ. of Colorado, Boulder). Dissertation Abstr., 22: 3129(Mar. 1962).

Relationships between boiling, condensing, and over-all heat transfer coefficients of hydrogen and the variables of temperature difference and heat flux were investigated. The apparatus utilized a smooth, vertical brass tube. Film condensation of hydrogen vapors took place within the tube whereas nucleate boiling of liquid hydrogen occurred on the outside of the tube. The hydrogen boil-off rate served as a measure of the heat transferred. Individual film temperature differences were obtained from thermocouple readings and thermal resistance calculations. Boiling heat transfer coefficients were determined for a Δt of 0.06 to 1.17°F and a heat flux range of 23 to 978 Btu/hr-ft^2 of boiling surface area. The values of the boiling coefficients obtained varied from 360 to 800 Btu/hr-ft^2-°F. Of the various theoretical and empirical equations for predicting boiling coefficients that were examined, the Forster-Zuber theory agreed within 12% with the data obtained at a temperature difference of 1.17°F. Other theories examined, however, showed less agreement with the experimental values. Condensing heat transfer coefficients were determined for the steady-state condensation of hydrogen vapor under laminar flow conditions. The range in Δt studied was 0.31 to 4.69°F and the corresponding heat flux range was 31 to 1310 Btu/hr-ft^2 based on the condensing surface area. The resulting condensing film coefficients varied from 90 to 300 Btu/hr-ft^2-°F and were all lower than those predicted by Nusselt's theory over this same Δt range. This is not surprising, however, since compliance with all of the numerous, idealized assumptions of Nusselt's theory may not have been completely possible in this investigation. Over-all heat transfer coefficients were determined for a temperature range of 0.38 to 6.06°F and a heat flux range of 23 to 978 Btu/hr-ft^2, based on the boiling surface area. These experimental values ranged from 44 to 146 Btu/hr-ft^2-°F and were approximately 16% larger than those predicted by a combination of the Forster-Zuber and Nusselt theories.

27205 EFFECT OF SURFACE EMISSIVITY ON HEAT TRANSFER BY SIMULTANEOUS CONDUCTION AND RADIATION. R. Viskanta (Argonne National Lab., Ill.) and R. J. Grosh. Intern. J. Heat and Mass Transfer, 5: 729-34(Aug. 1962). (In English)

An extension was made of a previous investigation to consider the effect of surface emissivity on temperature distribution and heat transfer in a thermal radiation absorbing and emitting media. Iterative-type solutions of a non-linear integral equation, which governs the temperature field, were obtained for a wide range of parameters. Temperature distributions are given in a graphical form and heat-transfer results are tabulated. (auth)

27206 PRESSURE DROP AND VAPOR VOLUME WITH SUBCOOLED NUCLEATE BOILING. D. P. Jordan (Univ. of California, Livermore) and G. Leppert. Intern J. Heat and Mass Transfer, 5: 751-61(Aug. 1962). (In English)

Reynolds' analogy between the transfer of heat and momentum was applied to forced-convection, subcooled boiling to predict the pressure drop. Experimental measurements of static pressure, vapor volume per unit area and heater wall temperature in an annular geometry permit the calculation of the local friction factor and the local Stanton number, from which it is demonstrated that the analogy gives a good approximation to the friction factor if a correction is made for the acceleration effects. However, this agreement was not found near the start of the heated length; local deviations of the measured quantities from those downstream were found in the entrance region. (auth)

27207 THE INFLUENCE OF PHYSICAL PROPERTY VARIATIONS ON LIQUID-PHASE MASS TRANSFER FOR

VARIOUS LAMINAR FLOWS. Donald R. Olander (Univ. of California, Berkeley). Intern. J. Heat and Mass Transfer, 5: 765-80(Aug. 1962). (In English)

The combined effect of density, diffusivity, and viscosity variations and of the velocity at the interface upon the rate of mass transfer from a rigid surface was investigated by a perturbation method. The analysis did not consider natural convection, and was restricted to systems of high Schmidt number (lower limit estimated at Sc = 100), for which the velocity profile in the diffusion boundary layer is linear. The diffusion equations for three diverse flow geometries, the rotating disk, the flat plate and the falling liquid film, are identical in form at high Schmidt numbers; the effect of the particular geometry is represented by a single parameter, which is characteristic of the limiting slope of the velocity profile near the surface. Application to three typical binary systems indicated that these phenomena can alter the Sherwood number by as much as 30% from its value in the absence of property variations and interfacial velocity. The corrections for variable properties and interfacial velocity may be applicable to a much wider class of solid boundary flows than the three cases considered, and to liquid-liquid systems for which the interface is rigid. (auth)

27208 MAGNETOHYDRODYNAMIC PIPE FLOW. PART 1. Richard R. Gold (Aerospace Corp., Los Angeles). J. Fluid Mech., 13: 505-12(Aug. 1962).

The solution is obtained to the problem of the steady one-dimensional flow of an incompressible, viscous, electrically fluid through a circular pipe in the presence of an applied (transverse) uniform magnetic field. A no-slip condition on the velocity is assumed at the nonconducting wall. The solution is exact and thus valid for all values of the Hartmann number. Excellent agreement exists between the present theoretical results and the experimental values obtained by Hartmann & Lazarus (1937) in the low to medium Hartmann number range. (auth)

27209 MAGNETOHYDRODYNAMIC PIPE FLOW. PART 2. HIGH HARTMANN NUMBER. J. A. Shercliff (Univ. of Cambridge, Eng.). J. Fluid Mech., 13: 513-18 (Aug. 1962).

An improved, second approximation for the laminar motion of a conducting liquid at high Hartmann number in nonconducting pipes of arbitrary cross section under uniform transverse magnetic fields is presented. A satisfactory comparison with the author's previously published experimental pressure gradient/flow results is made for the case of a circular pipe. (auth)

27210 A PERIODIC BOUNDARY-LAYER FLOW IN MAGNETOHYDRODYNAMICS. D. L. Turcotte and J. M. Lyons (Cornell Univ., Ithaca, N. Y.). J. Fluid Mech., 13: 519-28(Aug. 1962).

A boundary-value problem posed by induction electromagnetic pumps and generators is solved. Solutions are obtained by an expansion technique and a momentum method for the laminar, incompressible flow problem. For large values of the interaction parameter ($\mu^2\sigma H_0^2\lambda/\rho u_\infty$) viscous effects are shown to be restricted to periodic boundary layers. In regions of high field strength a local Hartmann solution is valid. Where the applied field is weak an inertial boundary layer is present which thickens in the upstream direction. A logical explanation of this phenomenon is given. The condition that a boundary-layer type flow exist is obtained and is shown to be in general satisified. The results show that inviscid theory may be used to calculate the overall performance of electromagnetic pumps and generators while the boundary-layer theory developed here may be used to obtain the wall shear stress. (auth)

27211 THERMOELECTRIC GENERATORS WITH SURFACE HEAT LOSS. H. B. Nottage, P. S. Starrett, and P. L. Winskell (Lockheed Aircraft Corp., Burbank, Calif.). J. Heat Transfer, 84: 193-206(Aug. 1962).

The influence of surface heat loss was treated analytically for unidimensional thermoelectric energy converters. Also, conditions were formulated whereby a gain in thermoelectric generator system efficiency can result from the transfer of heat from the thermoelectric conductors to a convecting fluid. While the general problem of the temperature distribution along the unidimensional conductor was described by a nonlinear differential equation, practical utility was demonstrated for linearization by assuring constant Thomson coefficient and mean-temperature properties within the range of most contemporary thermoelectric materials and applications. Influences of surface heat loss are discussed and demonstrated upon the longitudinal temperature distribution and the source and sink heat conduction rates. (auth)

27212 ON THE SIZE RANGE OF ACTIVE NUCLEATION CAVITIES ON A HEATING SURFACE. Y. Y. Hsu (National Aeronautics and Space Administration, Cleveland). J. Heat Transfer, 84: 207-16(Aug. 1962).

The importance of surface condition on nucleate boiling is recognized. It is also known that only cavities of a narrow size range can be active nucleation sites. In order to define the size range of active cavities as a function of wall temperature or heat flux, a model is proposed. The model pictures a bubble nucleus at a site enveloped by a warm liquid. The nucleus will begin to grow into a bubble only when the surrounding liquid is sufficiently superheated. The time required for the liquid to attain this superheat is called the waiting period. The transfer of heat from the superheated liquid into the bubble is considered to be a transient conduction process. A cavity is considered effective only if the waiting period is finite. This criterion gives the limiting sizes of effective cavities. The equations show that maximum and minimum sizes of effective cavities are functions of subcooling, pressure of the system, physical properties, and the thickness of the superheated liquid layer. Comparison of theoretical prediction with experimental data from several sources was made. The fluids considered were ether, pentane, and water, with water under various degrees of subcooling. The theory did predict the incipience of boiling and size range of cavities successfully. (auth)

27213 TRANSIENT POOL BOILING OF WATER ON A VERTICAL SURFACE WITH A STEP IN HEAT GENERATION. Henry Lurie and H. A. Johnson (Univ. of California, Berkeley). J. Heat Transfer, 84: 217-24(Aug. 1962).

An investigation was made on the transient heat transfer from a vertical submerged metallic ribbon undergoing a step in Joule heating leading to boiling on its surface. The tests were made in deaerated distilled water at atmospheric pressure with pool temperatures at saturation and 112°F subcooled, and with heat generation rates per unit of ribbon surface area from nonboiling to 1.6×10^6 Btu/ft^2 hr. Although the heat capacity of the ribbon was low, the surface temperature overshoot compared to the steady-state temperature was minor with values of less than 10°F. The time required to reach this overshoot, or the time required to reach steady state, was very short and decreased with increasing heat flux. These values were short compared to Goldstein and Eckert and Siegel's estimates of the time required to develop the hydrodynamic and thermal boundary layers in natural convection, and indicate that nucleate

boiling heat transfer is probably a weak function of the fluid circulation. Some further support for this was evidenced by calculated transient temperatures based on steady nucleate boiling heat transfer which are in reasonable agreement with the measured performance. (auth)

27214 FORCED CONVECTION HEAT TRANSFER FROM A UNIFORMLY HEATED CYLINDER. H. C. Perkins, Jr. and G. Leppert (Stanford Univ., Calif.). J. Heat Transfer, 84: 257-63(Aug. 1962).

Forced convection heat transfer from a cylindrical heating element with crossflow occurs in many situations of practical interest, but heat-transfer coefficients for liquids were previously reported in the literature only for Reynolds numbers below 200. New data taken with water and ethylene glycol at Reynolds numbers from 40 to 100,000 and Prandtl numbers from 1 to 300 were correlated. The effects of temperature differences large enough to produce significant changes in viscosity across the boundary layer were also investigated and are correlated in terms of a viscosity ratio. (auth)

27215 THE INFLUENCE OF TEMPERATURE DIFFERENCE ON THE TURBULENT FORCED-CONVECTION HEATING OF WATER. A. E. Bergles and W. M. Rohsenow (Massachusetts Inst. of Tech., Cambridge). J. Heat Transfer, 84: 268-70(Aug. 1962).

Studies were made of the effects of temperature difference Δt on the forced-convection heating of water. Data indicated that there is no great error introduced by assuming conventional correlations valid for low-temperature water at high Δt. The McAdams correlation equation, $(h/c_{pb}G)(c_p\mu/k)_b^{0.6} = 0.023/GD/\mu_b)^{0.2}$, gave the best results. The subscripts refer to the temperature at which the particular fluid property is evaluated. (M.C.G.)

27216 A THEORETICAL CONSIDERATION OF DIRECTIONAL EFFECTS IN HEAT FLOW AT THE INTERFACE OF DISSIMILAR METALS. Joon Sang Moon and R. N. Keeler (Univ. of California, Berkeley). A.I.Ch.E. Preprint 16. New York, American Institute of Chemical Engineers, 1962. 12p. (UCRL-9885(Rev.)). $0.50.

Several investigators have found that the resistance to heat transfer at certain metal-metal interfaces is dependent upon the direction of heat flow across these interfaces. It is shown that such a phenomenon can be explained by application of the theory of heat conduction in the solid state. (auth)

27217 FREQUENCY RESPONSE OF HEAT EXCHANGERS HAVING SINUSOIDALLY SPACE-DEPENDENT INTERNAL HEAT GENERATION. Wen Jei Yang (Univ. of Michigan, Ann Arbor). Preprint Paper No. 62-HT-21. New York, American Society of Mechanical Engineers, 1962. 7p. $1.00.

A general solution is presented for a transient in a heat exchanger resulting from an arbitrary space and time-dependent variation of heat generation which can be expressed by $\psi(x) \cdot \phi(\tau)$. These results, which were obtained by a direct mathematical attack on the governing differential equations, include the response of the solid and coolant temperatures. As a special case, the frequency response of a heat exchanger having sinusoidally space-dependent internal heat generation is given. A phenomenon of resonance in the amplitude-ratio and phase-shift is disclosed. Heat exchangers to which these results apply include the heterogeneous nuclear reactor. (auth)

27218 SEVERAL MAGNETOHYDRODYNAMIC FREE-CONVECTION SOLUTIONS. K. R. Cramer (Aeronautical Research Labs., Wright-Patterson Air Force Base, Ohio). Preprint Paper No. 62-HT-22. New York, American Society of Mechanical Engineers, 1962. 6p. $1.00.

The influence of transverse magnetic fields on the laminar free-convection flow of liquid metals over a vertical flat plate and between vertical parallel plates was examined for specific wall temperature variations and Prandtl numbers. The extent of influence on the flow and temperature fields was determined by the magnitude of a nondimensional influence parameter which is the ratio of the magnetic force to the bouyant force. In general, increasing the magnetic field strength decreased the magnitude of the velocity, wall shear, and surfaces heat transfer and increased the temperature throughout the fluid. Analytical results demonstrated that magnetic fields of practical strengths exert considerable influence on liquid metal free-convection flow fields. (auth)

27219 MULTIROD BURNOUT AT LOW PRESSURE. E. Janssen (General Electric Co., San Jose, Calif.). Preprint Paper 62-HT-26. New York, American Society of Mechanical Engineers, 1962. 9p. $1.00.

The effect of nonuniform heating, nonuniform spacing, and the presence of restrictions on burnout and the behavior of two-phase flow in a rod-type reactor fuel geometry were investigated. Tests were conducted using electrically heated rods and water at 30 psia. The results show that neither local power peaking of 17%, nor displacement of a rod from its normal position by 0.132 in., nor restriction of the flow by a plate-type spacer had any adverse effect on burnout. On the contrary, the presence of the spacer improved the burnout characteristics. (auth)

27220 EXPERIMENTS ON FORCED CONVECTION SUBCOOLED NUCLEATE BOILING HEAT TRANSFER. S. T. Hsu (Univ. of Wisconsin, Madison) and P. W. Ing. Preprint Paper No. 62-HT-38. New York, American Society of Mechanical Engineers, 1962. 12p. $1.00.

Experiments were performed on subcooled nucleate boiling under forced convection inside an Inconel tube of small diameter and high L/D ratio. The tube itself was used as a resistor for electrical heating. Water was used as the cooling fluid. Investigations included effects of pressure, inlet subcooling, and mass velocity on heat transfer; results of sudden change in heat flux; observations of temperature waves, stability and types of flow; and correlations of heat-transfer data. (auth)

27221 APPLICATION OF A MOMENTUM INTEGRAL MODEL TO THE STUDY OF PARALLEL CHANNEL BOILING FLOW OSCILLATIONS. J. E. Meyer (Westinghouse Electric Corp., Pittsburgh) and R. P. Rose. Preprint Paper No. 62-HT-41. New York, American Society of Mechanical Engineers, 1962. 9p. (WAPD-T-1363). $1.00.

A method is discussed for treating oscillations in flow through a heated boiling channel which connects two plenum regions of constant pressure difference. The approach is based on a numerical solution of pointwise difference equations representing conservation laws in fluid and metal. It is appropriate for spatially varying heat flux, flow with or without slip, and large perturbations. Details of the method, comparison with experiment, and features which distinguish it from other analytical models are discussed. (auth)

27222 BURNOUT AND PRESSURE-DROP STUDIES FOR FORCED-CONVECTION FLOW OF WATER PARALLEL TO ROD BUNDLES. S. J. Green (Westinghouse Electric Corp., Pittsburgh), G. W. Mauer, and A. Weiss. Preprint Paper No. 62-HT-43. New York, American Society of Mechanical Engineers, 1962. 12p. (WAPD-1137). $1.00.

Tests are reported which show that pressure drop and DNB correlations developed with rectangular channels are applicable for flow parallel to rod bundles. These tests were conducted using d-c resistance heating with vertical upflow of water through a heated nine-rod prototype of the PWR blanket rod bundle at 2000 psia with inlet temperatures of 400 to 625°F, mass velocities from 0.7 to 2×10^6 lb/hr-ft^2, at heat fluxes up to 1.4×10^6 Btu/hr-ft^2. The heated test section comprised nine rods 0.413 in. OD × 13 in. long on a 0.468 square pitch having a uniformly heated length of 9¼ in. (auth)

27223 THE EFFECT OF MULTI-PASS HYDRAULIC CORE CONFIGURATIONS IN PWR CORE 2. Frank R. Vaughan (Westinghouse Electric Corp., Pittsburgh). Preprint Paper No. 62-HT-45. New York, American Society of Mechanical Engineers, 1962. 9p. (WAPD-T-1365). $1.00.

One basic problem in reactor engineering is to determine a specific core hydraulic arrangement which provides the greatest heat removal capability with a fixed total reactor flow rate. The present analysis originally used in PWR Core 2 considers the heat removal characteristics for a general multi-pass reactor having N fuel assemblies. Peak and average power density in each assembly and an inter-pass mixing factor are considered to be fixed, known reactor characteristics. Number of passes, arrangement and sizing of assembly inlet orifices are assumed to be variables. A multi-pass core effectiveness is defined and a maximization process indicated. (auth)

27224 WALL TEMPERATURE VARIATION FOR MIST FLOWING THROUGH TUBES WITH CONSTANT HEAT FLUX. Jerald D. Parker (Oklahoma State Univ., Stillwater) and Richard J. Grosh. Preprint Paper No. 62-HT-47. New York, American Society of Mechanical Engineers, 1962. 6p. $1.00.

A study was made of the flow of a mist through a circular tube having a constant wall heat flux. The simple analytical model developed showed that severe wall temperature variations should be expected when an annular-mist flow changes, due to evaporation, to a true mist flow. In true mist flow two distinct types of heat transfer should be expected, depending upon whether the spheroidal state exists for the droplets striking the heated wall. Experimental data showed that the model qualitatively describes the tube-wall temperature variation with length. (auth)

27225 AN EXPERIMENTAL LOCAL BOILING HEAT-TRANSFER AND PRESSURE-DROP STUDY OF A ROUND TUBE. J. J. Jicha and S. Frank (Martin Marietta Corp., Baltimore). Preprint Paper No. 62-HT-48. New York, American Society of Mechanical Engineers, 1962. 20p. $1.00.

Local boiling heat-transfer and pressure-drop data were obtained for a tubular test section. The stainless-steel test section was 30 in. long and had a 0.416-in. ID. Fifteen wall thermocouples and five pressure-drop increments were employed to secure the data over the following range of parameters: system pressure at 800, 1100, 1300 and 1500 psia; flow rate at 1.2 × 9.0 gpm; and heat flux at 0.1×10^6 to 1.3×10^6 Btu/hr ft^2. The pressure-drop data were correlated using an equation of the form $f/f_{iso} = a + bj + c$ (Re). The pressure-dependent constants a, b, and c were established by a least-square fit of the data at each pressure. The linearity of the equation was verified by the computation of multiple correlation coefficients which ranged from 0.82 to 0.93. Calculated standard deviations ranged from 0.152 to 0.201. The equation developed was applied with fair success to the data of other investigations obtained at Prandtl numbers, pressures, and heat fluxes different from those of this study. (auth)

27226 BOILING HEAT TRANSFER AND MAXIMUM HEAT FLUX FOR A SURFACE WITH COOLANT SUPPLIED BY CAPILLARY WICKING. C. P. Costello and E. R. Redeker (Univ. of Washington, Seattle). A.I.Ch.E. Preprint 28. New York, American Institute of Chemical Engineers, 1962. 35p. $0.50.

Experimental results are presented for boiling heat transfer to ethanol from a stainless steel heater surrounded by a capillary wicking material. The ability of the wicking to convey coolant to a heater when the liquid level is such as to expose part of the heater is demonstrated. The effect of small accelerations directed normally toward the heater surface is studied. It is concluded that the full capabilities of capillary wicking to supply coolant to a heater cannot be realized without proper venting of vapor produced by boiling. Some recently obtained data are presented for a surface supplied with water by capillary action. In obtaining these data, proper venting was employed and extremely high heat fluxes were obtained, substantiating the conclusions of this paper. (auth)

27227 AN ANALOG SIMULATION OF THE TRANSIENT BEHAVIOR OF TWO-PHASE NATURAL CIRCULATION SYSTEMS. R. P. Anderson, L. T. Bryant, J. C. Carter, and J. F. Marchaterre (Argonne National Lab., Ill.). A.I.Ch.E. Preprint 27a. New York, American Institute of Chemical Engineers, 1962. 22p. $0.50.

The design of high-performance natural circulation boiling systems requires that the behavior of the systems be characterized under transient conditions. In order to accomplish this, the time and space dependent continuity, energy, and momentum equations for a natural circulation system are written. The resulting set of equations are solved simultaneously, utilizing an analog computer. A set of criteria that the analytical model has to satisfy is: (1) the model must provide an accurate steady-state calculation of the recirculation rate and vapor volume fraction for various power inputs; (2) it must reproduce the experimental transient behavior during varying power inputs; and (3) the model must accurately predict the inception of oscillations in a natural circulation system. The resulting equations are compared with experimental results at various pressures with two geometries in boiling water systems. The equations meet the established criteria, and the analytical model is useful for predicting the behavior of two-phase natural circulation systems during transients. The model accurately predicts the point at which such systems exhibit oscillatory behavior. The results were found to be very sensitive to the vapor-liquid velocity ratio (slip ratio) used in the computation. The velocity ratio correlation used in the model is presented. (auth)

27228 ENTRANCE REGION HEAT TRANSFER COEFFICIENTS. T. B. Davey (Sacramento State Coll., Calif.). A.I.Ch.E. Preprint 27. New York, American Institute of Chemical Engineers, 1962. 14p. $0.50.

A novel method of measuring heat transfer coefficients at the entrance of tubes for gases at elevated temperatures is described. Results are given for gas temperatures up to 1112°F with a Reynolds number of 19,623. A correlation is presented for the inlet region $1 < (X/D) < 8$. (auth)

27229 THE EFFECT OF AXIAL PROMOTERS ON THE HEAT TRANSFER AND PRESSURE DROP INSIDE A TUBE. Larry B. Evans and Stuart W. Churchill (Univ. of Michigan, Ann Arbor). A.I.Ch.E. Preprint 26. New York, American Institute of Chemical Engineers, 1962. 38p. $0.50.

The pressure drop and rate of heat transfer were measured for water flowing in a tube containing bluff-body promoters. Disks and streamline shapes of several sizes were mounted at various uniform spacings along a small, axially centered rod. Solid axial cores of various uniform diameters were also investigated. A uniform heat flux density was imposed along the wall and local heat transfer coefficients were determined from temperature measurements. The pressure drop and rate of heat transfer were both increased substantially by the streamline shapes and even more by the disks. Generalized empirical correlations are presented for the heat transfer coefficient and the effective drag coefficient or friction factor for disks, streamline shapes and annuli. The correlations provide the basis for selection and the economic evaluation of promoters. (auth)

27230 HEAT TRANSFER TO SUPERHEATED STEAM IN A THIN ANNULUS. Kenneth F. Neusen, Glenn J. Kangas, and Neil C. Sher (Allis-Chalmers Mfg. Co., Milwaukee). A.I.Ch.E. Preprint 23. New York, American Institute of Chemical Engineers, 1962. 34p. $0.50.

Heat transfer and pressure drop studies have been completed for superheated steam flowing in thin annular passages at 600 psia. The annuli were formed by an 0.878 in. OD tube inside of a 0.997 in. ID tube giving a gap of 0.0595 in. The 6 ft long tubes were held concentric by 3, 0.058 in. longitudinal wire spacers, 120° apart. Test conditions included Reynolds numbers from 35,000 to 140,000, heat fluxes as high as 125,000 Btu/hr-ft^2, and steam temperatures from saturation (489°F) to 1200°F. Local friction factors were measured for both heated and isothermal steam over the complete temperature range. Local heat transfer coefficients were measured on both the inner and outer heat transfer surfaces. Film coefficients and friction factors are compared with available correlations, and the effects of variable fluid properties and length to diameter ratio (heat transfer data were obtained for L/D_e up to 430) are discussed. (auth)

27231 EFFECT OF DIAMETER OF HORIZONTAL TUBES ON FILM BOILING HEAT TRANSFER. B. P. Breen and J. W. Westwater (Univ. of Illinois, Urbana). A.I.Ch.E. Preprint 19. New York, American Institute of Chemical Engineers, 1962. 27p. $0.50.

Tests were made to discover the limiting range of diameters for which the theoretical equation of Bromley for film boiling on horizontal cylinders is valid. Prior tests showed the equation to be adequate in the diameter range of roughly ¼ to ¾ inch, but not for electrically-heated wires of very small diameters. In the present study the range of tube diameters was extended up to 1.895 inch, using steam-heated, stainless steel tubes in a pool at atmospheric pressure. The liquids were at saturation conditions. Freon-113 was boiled at ΔT values (tube-to-liquid) from 190 to 350°F, and isopropanol was used at ΔT from 150 to 280°F. At each ΔT, the heat transfer coefficient decreased with increasing tube diameter until a critical diameter was reached. Further increases in tube diameter caused slight increases in the heat transfer coefficient. For Freon-113 the minimum h occurred at a critical diameter of about 0.48 in., whereas for isopropanol the value was about 0.66 in. Photography shows that, with large tubes, the pattern of bubble release is similar to that for film boiling on horizontal flat plates. It is not the narrow-slit pattern of vapor release which was Bromley's model. The critical tube diameter was found to be that which permits the development of hydrodynamic waves of the Taylor instability type on the top portion of the tube. All available pool film boiling data for the entire range of diameters from 0.004 to 1.895 in. can be correlated well by an equation which includes the critical wave length from hydrodynamic theory. The Bromley equation is applicable for the range, $\lambda_c/D = 0.8$ to 8. (auth)

27232 AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF PRESSURE TRANSIENTS ON POOL BOILING BURNOUT. John R. Howell and Kenneth J. Bell (Case Inst. of Tech., Cleveland). A.I.Ch.E. Preprint 18. New York, American Institute of Chemical Engineers, 1962. 21p. $0.50.

The effect of 5 to 10 psig/sec pressure decay rates on burnout in the pool boiling of water was studied. Initial saturation conditions at pressures of up to 62.5 psig were allowed to decay to one atmosphere, and the time to burnout of a stainless steel ribbon undergoing constant internal heat generation at near burnout conditions was studied. Heat fluxes ranged up to 5.75×10^6 Btu/hr-ft^2. The results are correlated on the basis of the steady state pressure vs. burnout heat flux curve which had previously been determined for the system. It is found that the time to burnout is almost invariably longer than would be predicted from the steady state curve and known pressure decay rates. (auth)

27233 GENERALIZED PREDICTION OF BURNOUT HEAT FLUX FOR FLOWING, SUBCOOLED, WETTING LIQUIDS. W. R. Gambill (Oak Ridge National Lab., Tenn.). A.I.Ch.E. Preprint 17. New York, American Institute of Chemical Engineers, 1962. 47p. $0.50.

A generalized two-term additive prediction method has been developed in which one term represents the boiling contribution to the burnout heat flux in the absence of forced convection and the other the equivalent forced-convection contribution in the absence of boiling. The predictions of this superposition method have been compared with all available experimental data (1263 points) for burnout with flowing, wetting liquids in the absence of significant net vapor generation. The data compared are for seven fluids in axial, swirl, and cross flow in tubular, annular, rectangular, and rod geometries over very broad ranges of flow conditions $-0.05 < V < 174$ fps, $4.2 < P < 3000$ psia, $0 < \Delta t_{sub} < 506$°F, $1 < a < 57{,}000$ g, and $0.1 \times 10^6 < \phi_{bo} < 37.4 \times 10^6$ Btu/hr·ft^2. When the data are excluded which can be shown to be unrepresentative of burnout under the experimental conditions, a selected data field of 815 tests remains. For these data, 95% of the predictions agree with the experimental values within a maximum deviation of 40%. The method is applicable to either correlation or prediction of burnout. Its predictions of burnout for liquid-metal systems are in much better accord with the early experimental results presently being reported than are those of other burnout correlation equations. The additive nature of the correlation allows it to escape the variable "constants" and exponents which tend to characterize most empirical broad-range burnout correlations. The relative importance of any one variable is shown by the additive approach to depend upon the relative contributions of the boiling and convective terms to the total heat flux at burnout. (auth)

27234 COOLING DEVICES FOR A THERMOELECTRIC GENERATOR. D. G. Gritton and Y. S. Tang (General Motors Corp., Indianapolis). A.I.Ch.E. Preprint 15. New York, American Institute of Chemical Engineers, 1962. 28p. $0.50.

One of the most important limitations on the performance of a thermoelectric generator is the capacity of heat rejection at the cold junction of the generator. For minimizing the weight and/or volume of the unit, the cold junction tem-

perature, cooling surface, and pumping power, if any, have to be optimized. Two types of cooling devices for a thermoelectric generator are described and the performance data are reported. The first one, a wire-coiled extended surface, removes heat through the natural convection mode and the second type, a transverse-finned surface, makes use of forced convection heat transfer for relatively large power output units. (auth)

27235 IMPROVEMENT OF HEAT EXCHANGES IN BOILING LIQUIDS UNDER THE INFLUENCE OF AN ELECTRIC FIELD. E. Bonjour, J. Verdier, and L. Weil (Centre d'Etudes Nucleaires, Grenoble, France). A.I.Ch.E. Preprint 7. New York, American Institute of Chemical Engineers, 1962. 18p. $0.50.

It is shown that notable improvements in heat exchange coefficients may be obtained in some cases multiplied by factors ranging from 4 to 10. On a more fundamental basis, mechanisms are described and connected with the physical characteristics of the fluids leading to such improvements. The experimental work used a wire heated electrically, of diameter of 0.1 or 0.2 mm. The electrical field was produced on this wire by means of a parallel linear electrode, an alternating potential being applied between them. (auth)

27236 SUBCOOLED BOILING HEAT TRANSFER TO AQUEOUS BINARY MIXTURES. William J. Rose, Herbert L. Gilles, and Vincent W. Uhl (Drexel Inst. of Tech., Philadelphia). A.I.Ch.E. Preprint 6. New York, American Institute of Chemical Engineers, 1962. 27p. $0.50.

Binary aqueous mixtures of methyl alcohol, ethyl alcohol, isopropyl alcohol, n-butyl alcohol, and the pure components were subjected to subcooled nucleate boiling in an annulus on the surface of an electrically heated type 304 stainless steel heating element. Data were obtained at a pressure of 30 psia and a velocity of 4 ft/sec with subcooling between 60° and 110°F; the heating element was a ¼-inch O.D. by 6-inch long cylindrical tube with a measured wall thickness of 0.015 inch. The data are presented as plots of heat flux versus wall superheat and indicate that greater superheat is required to produce a given heat flux for the mixtures than for either of the pure components. This phenomenon is emphasized by plots of the wall superheat required to produce a given heat flux versus mixture composition and all show maxima at an intermediate concentration. These maxima occur when the constituent with the higher boiling temperature is dominant. The occurrence of these maxima is supported by recent theoretical and experimental studies which show that the rate of growth of vapor bubbles is a function of composition and also that the minimum rate of bubble growth occurs at an intermediate composition predominant in the high boiler. (auth)

27237 DISTRIBUTION OF ACTIVE SITES IN THE NUCLEATE BOILING OF LIQUIDS. R. F. Gaertner (General Electric Research Lab., Schenectady, N. Y.). A.I.Ch.E. Preprint 5. New York, American Institute of Chemical Engineers, 1962. 30p. $0.50.

A statistical treatment is given of the only existing data for the spatial distributions of boiling nucleation sites on a copper surface. The local density of nucleation sites for boiling water containing dissolved nickel salts, at heat fluxes of 200,000, 294,000, and 317,000 Btu per hr. sq. ft., were found to fit a Poisson distribution quite well. The fraction of the surface having a local active site population N in local areas a is given by the equation, $P_a(Na) = [e^{-\bar{N}a}(\bar{N}a)^{Na}/(Na)!]$, and the distribution of nearest-neighbor distances having a value between S and S + dS by the equation, $P(S) = 2\pi\bar{N}S\, e^{-\bar{N}\pi S^2}\, dS$. This result shows that the average distance between nearest-neighbot sites is $\bar{S} = \frac{1}{2}\bar{N}^{-\frac{1}{2}}$. It was concluded that "patchwise boiling," often observed on isotropically polished surfaces uniformly heated at low Δt, is not real but is a visual manifestation of a completely random spatial distribution of active sites. From a cursory examination of published data for five liquids boiling from three different surfaces it was also found that the population of active sites depends on surface temperature according to the equation, $\bar{N} = N_0 e^{-K/T_w^3}$, as expected from classical nucleation theory. (auth)

27238 THE ECONOMICS OF USING PROMOTERS TO IMPROVE HEAT TRANSFER INSIDE TUBES. Larry B. Evans and Stuart W. Churchill (Univ. of Michigan, Ann Arbor). A.I.Ch.E. Preprint 3. New York, American Institute of Chemical Engineers, 1962. 26p. $0.50.

A method is presented for determining the economic feasibility of using promoters in a heat transfer tube. The procedure requires that the rate of heat transfer and the pressure drop be known as a function of flow rate and fluid properties for the promoters under consideration. Recent empirical correlations for the heat transfer and pressure drop in tubes containing promoters are reviewed and converted to a common form. The promoters include roughening elements on the tube wall, twisted metal strips, packing material, solid axial cores, and bluff bodies centered in the tube. The method of economic analysis is illustrated for a representative application. It is shown that in certain situations a distinct monetary savings can be realized by the use of the proper promoter. In many cases the use of the promoter can provide flexibility in design and operation. On the other hand, misdesign or misoperation of an exchanger containing a promoter can be very expensive. The advantages and disadvantages of various types of promoters are discussed. (auth)

27239 TUBE SIDE FLOW DISTRIBUTION EFFECTS ON HEAT EXCHANGER PERFORMANCE. J. S. McDonald and K. Y. Eng (Atomics International, Canoga Park, Calif.). A.I.Ch.E. Preprint 2. New York, American Institute of Chemical Engineers, 1962. 17p. $0.50.

In the design of most conventional heat exchangers, it is usually assumed that the flow of tube side fluid is divided uniformly among the tubes. However, this in general is not the true flow condition. To evaluate the effects of nonuniform distribution of tube side flow on the total heat transfer in single-pass, cross flow exchangers, an investigation was carried out using electronic analog equipment. The different types of tube side flow apportionment considered included uniform distributions and distributions both symmetrical and nonsymmetrical with respect to the middle row of the tube bank. The results of runs for which the operating values were equal, but for which flow distributions were different, were compared and the influence of various operating parameters was studied. For the cases considered, it was found that for a given set of operating conditions, the maximum deviation of total heat transfer with nonuniform tube flow characteristics from that obtained under uniform conditions was ~4%. (auth)

27240 THE EFFECT OF PRESSURE, GEOMETRY, AND THE EQUATION OF STATE UPON THE PEAK AND MINIMUM BOILING HEAT FLUX. J. H. Lienhard (Washington State Univ., Pullman) and V. E. Schrock. Preprint Paper No. 62-HT-3. New York, American Society of Mechanical Engineers, 1962. 8p. $1.00.

The peak and minimum boiling heat fluxes for a variety of fluids were correlated with pressure, with geometry as a parameter. These correlations were achieved with the use of nondimensionalizing functions of invariant fluid properties that are based upon Zuber's proposed mecha-

nism for the extreme heat fluxes and upon the Law of Corresponding States. The method of correlation was applied with success to data from the literature as well as to new measurements provided by the authors. A clear contribution of geometry was identified. (auth)

27241 ON THE HYDRODYNAMIC TRANSITIONS IN NUCLEATE BOILING. Raphael Moissis (Massachusetts Inst. of Tech., Cambridge) and Paul J. Berenson. Preprint Paper No. 62-HT-8. New York, American Society of Mechanical Engineers, 1962. 6p. $1.00.

The two hydrodynamic transitions which take place in nucleate boiling off a horizontal surface are described. The first, which is governed by continuity considerations, results in a change in the vapor removal process from an intermittent to a continuous one. The second, which is a result of a Taylor-Helmholtz instability, determines the maximum ("burnout") heat flux. Equations are presented which predict with good accuracy the two transition heat fluxes. (auth)

27242 SURFACE RECOMBINATION AND HEAT TRANSFER IN A DISSOCIATED DIATOMIC GAS. PART 1. W. B. Cottingham (Bell Telephone Labs., Whippany, N. J.) and R. J. Grosh. Preprint Paper No. 62-HT-12. New York, American Society of Mechanical Engineers, 1962. 6p. $1.00.

A method is described for the investigation of surface catalytic effects and heat transfer in a dissociated diatomic gas. Description is given of the experimental apparatus and the method and theory of testing. (auth)

27243 SURFACE RECOMBINATION AND HEAT TRANSFER IN A DISSOCIATED DIATOMIC GAS. PART 2. W. B. Cottingham (Bell Telephone Labs., Whippany, N. J.) and R. J. Grosh. Preprint Paper No. 62-HT-13. New York, American Society of Mechanical Engineers, 1962. 4p. $1.00.

Results are presented for the recombination coefficient of hydrogen atoms on a stainless-steel surface as a function of pressure, temperature, and concentration. These results are compared with theoretical predictions. Results are also presented for a heat-transfer ratio. The results cover a range of Knudsen numbers from 0.08 to 4.2, a range of Reynolds numbers from approximately 0.004 to 0.2, and an up stream Mach number of approximately 0.1. (auth)

27244 PREDICTION OF THERMAL CONDUCTANCE OF METALLIC SURFACES IN CONTACT. H. Fenech and W. M. Rohsenow (Massachusetts Inst. of Tech., Cambridge). Preprint Paper No. 62-HT-32. New York, American Society of Mechanical Engineers, 1962. 10p. $1.00.

A mathematical analysis of a thermal contact was first carried out on an idealized shape of contact point. The thermal conductance is expressed in terms of the thermal conductivities of the metals and of the fluid filling the voids, the real area in contact, the number of contact points per unit area, and the volume average thickness of the void gaps. A method is given for the determination of these physical properties of a contact. To use this method the following measurements are needed: two recorded profiles, perpendicular to one another; and a Knoop hardness test on the softer of the two metals making the contact. The experimental verification of the assumptions made in the theoretical analysis and the application of the method outlined for the case of an iron-aluminum contact are described. Good agreement was found between the predicted and measured conductance over a range of pressures from 90 to 2600 psi. (auth)

27245 SOME POSSIBLE CRITICAL CONDITIONS IN NUCLEATE BOILING. Yan-Po Chang (Univ. of Buffalo). Preprint Paper No. 62-HT-37. New York, American Society of Mechanical Engineers, 1962. 11p. $1.00.

Certain basic ideas from which several critical conditions are derived were introduced into boiling heat transfer. The heat transfer in nucleate boiling is considered as being limited by the maximum rate of bubble generation from a unit area of the heating surface. With certain simplified assumptions, an equation was obtained for the first critical heat flux of nucleate boiling with and without forced convection and subcooling. (auth)

27246 FORCED FLOW ONCE THROUGH STEAM GENERATOR ASSOCIATED WITH A GAS-COOLED NUCLEAR REACTOR. Otto Engler (to Vereinigte Kesselwerke A.G.). British Patent 900,821. July 11, 1962.

A forced-flow once-through steam generator of circular cross section is designed for use in the same container with a gas-cooled reactor. The tubes of the steam generator are arranged in a series of superposed horizontal circular plenums and are bent into involutes. The steam generator permits defective parts to be taken out of operation and reactor operation continued with the remaining tube systems. (D.L.C.)

27247 IMPROVEMENTS IN OR RELATING TO STEAM GENERATORS. Michael Gordon Bennett (to United Kingdom Atomic Energy Authority). British Patent 903,443. Aug. 15, 1962.

A steam generator of the shell-tube bank type and constructed from conventional pressure vessel steels is designed for use with a high-temperature, high-pressure gas (~1000°F, 150 psi). In addition to the pressure shell, evaporator tubes, and superheater tubes, the generator has water jacket cooling means for the inside wall of the shell. (D.L.C.)

Instrumentation

Refer also to abstracts 27724 and 28360.

27248 (AHSB(RP)R-19) PROCEEDINGS OF SYMPOSIUM ON FILM BADGE DOSIMETRY, HARWELL, OCTOBER 1961. W. A. Langmead and N. Adams, eds. (United Kingdom Atomic Energy Authority. Authority Health and Safety Branch. Radiological Protection Div., Harwell, Berks, England). June 1962. 99p.

The texts of the principal papers and summaries of discussion on film badge dosimetry are presented. Various systems used for film badges, the photographic action of ionizing radiation, the comparative response of various photographic films, and problems encountered in personnel monitoring are reviewed. The design is described of a film badge for use in radiation monitoring of personnel in industrial, technical, and hospital establishments. The case of the holder is of a plastic material and filters of 0.028-in. Al plus 0.012-in. Pb, and 0.028-in. Cd plus 0.040-in. Duralumin are inserted. Spaces are also provided for an additional metal filter and for In foil. A slot is provided for attachment of a second dosimeter or criticality pack. Kodak radiation monitoring film is used in the holder. Data are included on the response of the dosimeter to x and γ radiations, thermal neutrons, and β particles. The usefulness of the dosimeter in large-scale film monitoring is discussed. (C.H.)

27249 (AROD-2504:2) TEMPERATURE MEASUREMENTS IN OXY-HYDROGEN FLAMES USING SCATTERED NEUTRONS AND CONVENTIONAL METHODS (thesis). Final Technical Report. R. M. Delaney and A. H. Weber (Saint Louis Univ.). June 15, 1962. 54p.

A summary of the experimental work undertaken to verify the feasibility of using thermal neutrons from a nuclear reactor to measure the temperature of hydrogenous plasmas is presented. Results are presented of an experiment in which the temperature of an oxy-hydrogen flame burning at reduced pressures was measured by means of the observed transmission of scattered neutrons through Cd foils. The theory developed in a previous report is applied to determine the temperature of the flame. Temperature measurements made in the same apparatus by means of an optical pyrometer and thermocouples are also discussed. Comparison of all measured temperatures with published and theoretically predicted temperatures is made and discussed. (auth)

27250 (CTSL-31) LEAD GLASS TOTAL ABSORPTION COUNTERS. H. Ruderman, R. Gomez, and A. V. Tollestrup (California Inst. of Tech., Pasadena. Synchrotron Lab.). Feb. 26, 1962. Contract AT(11-1)-68. 18p.

Two large identical lead glass Cherenkov counters were built to detect and measure the energies of decay photons from neutral pions. It is noted that this method of detecting high energy gamma radiation has the advantage of 100% efficiency, good energy resolution, linearity of response, insensitivity to heavy charged particles and short time resolution. A description of operation principles is given along with details of construction, response characteristics, and performance. (J.R.D.)

27251 (CTSL-35) A 25 INPUT PULSE HEIGHT RECORDING SYSTEM. D. E. Groom and J. H. Marshall (California Inst. of Tech., Pasadena. Synchrotron Lab.). July 11, 1962. Contract AT(11-1)-68. 28p.

Description is given of a data recording system which provides a link between counter experiments in high-energy physics and a high-speed digital computer. The instrument described can accept as many as 25 simultaneous photomultiplier tube signals and pulse height analyse them into 100 channels each. Six bits of digital data may be substituted for any unused pulse height input. The usual output is perforated paper tape with a binary coded decimal format for use with a Burroughs 220 computer. Identification words can be set up and recorded on the tape. The speed of the paper tape perforator limits the rate of analysis to one event per second. If the output data are fed directly into a computer memory, then the recording rate can be increased to 60 events per second. The instrument has been in operation since December 1961, and results obtained with it using both particles produced by the Caltech Synchrotron and pulsers are given. Only solid state components have been used, including nearly 1700 transistors and an equal number of diodes. (auth)

27252 (DP-731) A POWER SUPPLY FOR AN ELECTRON BEAM WELDER. Harold S. Sanders (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). June 1962. Contract AT(07-2)-1. 10p.

A high voltage supply for an electron beam welder was constructed from a surplus Oak Ridge Alpha I calutron power supply. An electron gun with horizontal and vertical position adjustment was constructed and installed in a rebuilt dry box. (auth)

27253 (HW-65444) INVENTION REPORT: A DUAL SCANNING SYSTEM FOR REACTOR FUEL FAILURE DETECTION. R. S. Paul (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1, 1960. Contract AT(45-1)-1350.

A system for monitoring a large number of continuously flowing effluent coolant samples from a nuclear reactor for small traces of fission product gamma activity resulting from a fuel element failure is described. Scanning functions are performed by rotating scintillation type detectors past a circular array of about 100 shielded sample chambers, each fed from an individual reactor process channel. The system has a fast-scan gross-gamma monitor to detect rapid burst-type failures and a slow-scan higher-sensitivity gamma monitor to confirm threshold signals from the gross monitor. (M.C.G.)

27254 (HW-73335) FEASIBILITY STUDY OF IN-CORE NEUTRON FLUX MONITORING WITH REGENERATING DETECTORS. D. E. Hegberg (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1962. Contract AT(45-1)-1350. 67p.

The requirements and objectives of in-core flux monitoring are briefly considered. A methodology is presented concerning the feasibility of developing regenerating detectors, which are combinations of fertile and fissile nuclides, for extended in-core use. Four hypothetical in-core locations are considered and used to examine the behavior of four types of regenerating detectors composed of uranium and/or plutonium nuclides. Optimum compositions are determined for each location. It is shown that the regeneration mechanism categorizes as a Phoenix-like action, a state of secular equilibrium, or a combination. Sensitivity and useful lifetime characteristics of the detectors are discussed through the effects of variations in composition and changes in hypothetical environment. The environmental variations include shifts in the level and distribution of the reactor spectrum and in detector exposure. It is concluded that regeneration detectors are feasible and present an operational gain over single nuclide detectors. Finally, proposed experimental methods are discussed. (auth)

27255 (JINR-P-895) DEKADNYI PERESCHETNYI PRIBOR S RAZRESHAYUSHCHIM VREMENEM 10^{-7} SEK NA POLUPROVODNIKOVYKH TRIODAKH. (A Decade Conversion Apparatus with 10^{-7} sec Resolution Time on Semiconductor Triodes). I. F. Kolpakov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 15p.

A transistorized decade scalar with the counting capacitance of 10^8 pulses and 10^{-7} resolution time is described. The maximum counting rate is 5 M/C. The circuit contains 8 decades, a stabilized supply unit, and a control unit. Driving diode gates attached to the binaries minimized the number of the necessary triodes and gave, as a result, reliable and easy to make circuits. A complete interchangeability of plug-in decades provides for fast repair when failure takes place. The device has provisions for manual and automatic operation, and can be also driven by the outer timer. It has the power consumption of 4w. (auth)

27256 (KR-23) WATER LEVEL INDICATOR. I. Oerbeck (Norway. Institutt for Atomenergi, Kjeller). May 1962. 20p.

Description is given of a water level indicator designed to operate inside a reactor vessel. The indicator is a level feeler gauge, using a dip electrode as the sensing element. Alternative sensing elements are described. The dip electrode is made to oscillate at the water surface and it follows the water level automatically. Read-off intervals and read-off time are adjustable. The performed differential accuracy is ±0.1 mm. (auth)

27257 (LA-2679) THE PHOTON ENERGY RESPONSE OF SEVERAL IONIZATION CHAMBER INSTRUMENTS. Donald A. McKown and Ellery Storm (Los Alamos Scien-

tific Lab., N. Mex.). Feb. 1962. Contract W-7405-ENG-36. 25p.

The photon energy response of several radiation survey meters and pocket dosimeters was measured over an energy range of 8 to 1250 kev. Measurements were also taken with the meters in different orientations and with open and closed shield. The devices selected for these measurements are all ionization chamber instruments in routine or special use at the Los Alamos Scientific Laboratory. (auth)

27258 (LA-2691) AN APPARATUS FOR THERMOGRAVIMETRIC ANALYSIS IN CONTROLLED ATMOSPHERES. Earl L. Head and Charles E. Holley, Jr. (Los Alamos Scientific Lab., N. Mex.). May 1962. Contract W-7405-ENG-36. 20p.

An apparatus system is described for thermogravimetric analysis in controlled atmospheres or vacuum. The various parts of the system are described in detail. Estimates are made of the attainable precision and accuracy. Experimental results on the reaction between carbon and carbon dioxide are given. (auth)

27259 (NP-11792) EFICIENCIA DE UN CONTADOR GEIGER-MÜLLER. (Efficiency of Geiger-Müller Counter). Jacobo Rapaport (Chile. Universidad, Santiago. Instituto de Fisica y Matematicas). May 1960. 17p.

Factors affecting the efficiency of a Geiger-Müller counter are given, and the experimental techniques used to measure each of these factors are described. The values obtained for each factor are shown in graphic and tabular form. (J.S.R.)

27260 (NP-11864) DVOINOI BEZZHELEZNYI β-SPEKTROMETER S TOROIDAL'NYM POLEM. (Double Nonferrous β-Spectrometer with a Toroidal Field). E. F. Tret'yakov, L. N. Kondrat'ev, G. I. Grishuk, G. I. Novikova, and L. L. Gol'din (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki). 1962. 15p.

A design is given of a double iron-free β spectrometer with a toroidal field and two identical coils containing 600 loops. The coils are supplied independently or in sequence. The geometry is 10% of 4π. Resolving power with series connected coils is 0.3%. (tr-auth)

27261 (NRL-5792) THERMOELECTRIC INSTABILITY OF SOME NOBLE METAL THERMOCOUPLES AT HIGH TEMPERATURES. B. E. Walker, C. T. Ewing, and R. R. Miller (Naval Research Lab., Washington, D. C.). June 29, 1962. 19p.

Thermoelectric instabilities of noble metal thermocouples and individual thermoelements (Pt, Rh, Ir, Ir-50% Rh, and several Pt–Rh alloys) were studied from 1000 to 1700°C under oxidizing and neutral atmospheres. The principal source of instability was found to be a contamination of the thermoelements by impurities from ceramic protection tubes. Several grades of alumina sheathing were tested, and thermocouple errors associated with each grade were determined. With alumina sheathing the principal contaminant was iron, and the instability generated was at least an order of magnitude greater in a neutral atmosphere than in an oxidizing atmosphere. Increasing the wire size increases stability in a neutral atmosphere, although not in an oxidizing atmosphere. Instability increases rapidly with temperature between 1000 and 1700°C, but the order of decreasing stability remains Pt-6% Rh/Pt-30% Rh, Pt-1% Rh/Pt-13% Rh, and Pt/Pt-10% Rh or Pt/Pt-13% Rh. The instability of pure rhodium thermoelements, and of Ir and Ir-50% Rh thermoelements, depends on internal changes, and not as much on iron contamination as the Pt–Rh series of thermoelements; hence the pure rhodium and the iridium thermoelements become preferable if gross iron contamination is expected. When compositional changes are expected in a thermoelement, immersion depth should be maintained constant or increased. (auth)

27262 (NYO-10086) FABRICATION OF SEMICONDUCTOR DEVICES BY NEUTRON TRANSMUTATION DOPING. Quarterly Progress Report No. 2, March 1962–June 1962. Carl N. Klahr (Fundamental Methods Associates, New York). June 22, 1962. Contract AT(30-1)-2914. 15p.

Progress is reported in the detailed development of fabrication methods for semiconductor devices by neutron transmutation doping. The degree of precise spatial control which can be obtained in the impurity distribution within the semiconductor is investigated. Several slit patterns were calculated. The magnitude of the potential barrier attainable in the P-N junctions was estimated, and work has begun on consideration of figures of merit of the devices that can be produced. It is concluded that the radiation die process will be technically feasible and that a proof-of-principle experiment presents no major difficulties. (auth)

27263 (TID-16326) AN INVESTIGATION OF THE SILICON SURFACE-BARRIER FAST NEUTRON SPECTROMETER (thesis). Robert Lee Kelly (Washington. Univ., Seattle). 1962. 61p.

The use of surface-barrier solid state detectors for charged particle and neutron spectrometers was investigated. Manufacturing methods for charged particle detectors using 400–500 ohm cm n-type silicon were tested to obtain the best combination of procedures that would yield consistently good detectors. These methods were used to make detectors from 1200–1300 ohm cm silicon for a fast neutron spectrometer. The results of the investigation demonstrated that neutron spectrometers using surface-barrier detectors could be made if special attention was paid to the detail of their manufacture. The spectrometer's efficiency and reaction cross-section for different energy neutrons will have to be investigated more thoroughly before very useful data can be obtained from the reactor measurements. (auth)

27264 (UCRL-9809) ELECTRON-TRACK COUNTING FOR BETA SPECTROSCOPY. Kenneth D. Sevier (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1, 1961. Contract W-7405-eng-48. 11p.

An electron-sensitive Ilford K5 emulsion was exposed in a permanent-magnet spectrograph to the small energy region from 312 to 324 kev of the beta spectrum of Pa^{233}. Comparison of this detection method with that of exposing an x-ray photographic film indicated an increase in sensitivity by a factor of eight. Also, there were four possible new lines observed. The techniques and advantages of this method are considered. (auth)

27265 (UCRL-13041) DESIGN AND RESPONSE OF SEMICONDUCTOR DETECTORS TO HIGH INTENSITY TRANSIENT γ PULSES. Final Report. F. P. Burns, K. Starnes, R. Alexander, et al. (Solid State Radiations, Inc., Los Angeles). May 11, 1962. For University of California, Lawrence Radiation Lab., Livermore. Contract [W-7405-eng-48]; Subcontract 8572707. 59p.

The response of 3 types of silicon junction detectors to high intensity transient γ pulses was measured. The important differences among the detectors are depth of depletion region and electric field distribution within the device. The distinguishing features of the physical and electrical structure of the PIN, LID, and NPS detectors are described and compared. A brief description of the fabrication pro-

cedures is given. For maximum speed of response, the PIN detector was found to be most suitable, while for maximum sensitivity the lithium ion drift (LID) detector yielded best results. The sensitivity of the devices was found to be proportional to the depth of the depleted or space charge region of the detector. The results show that silicon devices specifically designed for γ ray detection have distinct advantages over more conventional detectors. Design modifications are suggested to increase performance. (C.H.)

27266 (UNM-TR-EE-66) THE MEASUREMENT OF INSTANTANEOUS POWER UTILIZING THE HALL GENERATOR. Bill J. Harper (New Mexico. Univ., Albuquerque, Engineering Experiment Station). Feb. 1962. For Sandia Corp., Albuquerque, N. Mex. 36p. (SCDC-2636)

Properties of the Hall generator are described including electrical specifications and maximum ratings. Circuit aspects of the Hall generator for use in multiplication of two electric quantities are discussed. A circuit incorporating the Hall generator for measuring instantaneous power was developed. (M.C.G.)

27267 (USNRDL-TR-569) EVALUATION AND CALIBRATION OF AN ELECTRONIC PARTICLE COUNTER FOR MULTISPECIES BLOOD CELL ENUMERATION. W. G. Wisecup and B. G. Crouch (Naval Radiological Defense Lab., San Francisco). June 20, 1962. 23p.

In order to standardize procedures and allow for large numbers of determinations in a relatively short time, a Coulter Model A Electronic Particle Counter was calibrated for enumerating total erythrocyte and leucocyte counts in twelve mammalian species. Standard values were obtained with blood from each species for all instrument settings (threshold, aperture current, etc.) and for optimal amounts of a stromatolytic agent for enumerating leucocytes. Two identical instruments were compared to determine the feasibility of using standard settings from one instrument to another. Findings showed that for the burro, dog, goat, guinea pig, hamster, man, monkey, mouse, rabbit, rat, sheep and swine the enumeration of total erythrocytes and leucocytes can be easily and accurately determined using the Coulter Counter. Further evidence suggests that standardized settings may be used with other instruments of the same model. (auth)

27268 (AWRE/Trans/35) INDUCTANCE OF SECTIONAL PAPER CAPACITORS. G. S. Kuchinskii and K. M. Irkaeva. Translated by F. E. Wallwork (U.K.A.E.A. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) from Vestnik Elektroprom., 32: No. 11, 38-41(1961). 18p.

The inductance of a paper section of pulse capacitors is basically determined by its geometric dimensions, the number of leads, and their dimensions and position. The methods for measuring and results obtained are discussed along with the capacitor design. To produce the maximum resonance frequency and minimum wave impedance an increase in the section is best effected by increasing the width of the foil used in winding the section. (N.W.R.)

27269 (FTD-TT-62-643) PERSONNEL MONITOR FOR HARD BETA AND GAMMA RAYS. W. Herrmann and K. Renker. Translated from Kernenergie, 4: Nos. 10-11, 826-9(1961). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 14951.

27270 (FTD-TT-62-863) SEMICONDUCTOR α-PARTICLE DETECTORS. Janina Chwaszczewska (Chwaszczewska), Stefan Chwaszczewski (Chwaszczewska), and Kazimerz Dybowski. Translated from Nukleonika, 6: 635-41(1961). 6p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 7708.

27271 (NP-tr-906) SECONDARY RADIATION EFFECTS IN THE PHOTOGRAPHIC ACTION OF ALPHA RAYS. R. H. Herz. Translated by J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Strahlentherapie, 94: 455-9(1954). 11p.

The photographic action of alpha particles is accompanied by secondary radiation effects, which may falsify the evaluation of photographic results if correct allowance is not made. On exposure of a double emulsion x-ray film to alpha radiation, a peculiar dip was noted in the density curve. This dip was found to be due to a composite radiation, consisting of a visible fluorescence radiation (mainly from the bromide-iodide) and another component which appears to be identified with K radiation from the copper base. This observation of fluorescence of silver bromide-iodide was made at room temperature. (auth)

27272 (SCL-T-421) ON THE DEVELOPMENT OF A NEUTRON CONDUCTOR IN AN FRM REACTOR. Josef Christ and Tasso Springer. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Nukleonik, 4: No. 1, 23-5(Feb. 1962). 7p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 19117.

27273 THE CHARACTERISTICS OF NEUTRON CHOPPERS WITH CURVED SLITS AT THE INSTITUTE OF ATOMIC PHYSICS AT BUCHAREST. H. Teutsch, N. Mateescu, P. Pîrlogea, C. Rădulescu, P. Timiş, and V. Vasiliu (Inst. for Atomic Physics, Bucharest). Acad. rép. populaire Roumaine, Rev. phys., 6: 411-17(1961). (In German)

The construction of a neutron chopper with curved slits, designed for use with cold neutrons, is described, and the results obtained in the determination of its physical parameters are reported. The physical parameters measured were cold-neutron transmission, resolution, and epithermal-neutron transmission. (J.S.R.)

27274 SODIUM IODIDE CRYSTAL OF WELL-TYPE FOR IN VIVO GAMMA RAY MEASUREMENTS. Leif Hallberg and Norman Veall (Univ. of Gothenburg, Sweden and Guy's Hospital Medical School, London). Acta Radiol., 58: 210-14(June 1962). (In English)

An improved scintillation counter collimator system was devised based on the non-uniform response of a well-type sodium iodide crystal fitted with a tapered collimator and a removable conical lead insert in the well. The tracer dose administered to the patient can be reduced by at least a factor four as the sensitivity was 6 times higher than a conventional 1.8 cm diameter cylindrical collimator at the same resolving power (I^{131}). The instrument can easily be converted into a conventional well-type scintillation counter. (auth)

27275 RADIATION DOSIMETRY BY MEANS OF SEMICONDUCTORS. Tom Guldbrandsen and C. B. Madsen (Radium Centre for Jutland, Aarhus, Denmark and The Radiophysical Lab., Aarhus, Denmark). Acta Radiol., 58: 226-32(June 1962). (In English)

Different commercial diodes were used as dosimeters. It is shown that the shortcircuit current is a simple function of the dose rate, and that it is independent of the quality of the radiation in the region 0.5 to 2.5 mm Cu HVL. (auth)

27276 RADIATION ANALYZERS. Harold T. Peterson, Jr. Atomics, 15: 28-31(1962).

The components of radiation analyzers (i.e., detectors, discriminators, memory or recording devices, readout or display devices, and associated circuitry) are discussed. The characteristics of integral, differential, and multichannel analyzers are outlined. (T.F.H.)

27277 PCY-1 LIQUID LEVEL GAGE USING RADIOISOTOPES. V. S. Gostishchev and A. D. Kulikov. Byull. Tekh. Ekson. Informi., No. 2, 26-9(1962).

A float-actuated gauge for measuring and regulating liquid levels in closed and open containers and for dosing liquid volumes was developed and successfully tested. The gauge consists of an electronic relay unit (a two-channel gamma relay) and a column containing the control mechanism. An electromagnetic reversible starter is used to reverse the motor employed in the control mechanism. The electronic relay unit is located in a hermetically sealed Silumin body divided by a partition into two uneven parts: the larger contains the unit, the other, the clamping block. The float, which contains a γ-radiation source (Co^{60} or Cs^{137}) with an activity of 0.1 to 0.2 mg-equiv radium, was manufactured from stainless steel, teflon, glass, or other materials. The specifications are as follows: range of level measurement, 0 to 1000 m; accuracy of level measurement, ±10 mm; tracing speed, 500 mm/min; minimum counter irradiation intensity, 100 pulses/sec; rated power-supply voltage of the electronic relay unit at a 50 cps frequency, 220 v; maximum current through control element contacts, 3 amp; overall dimensions of the relay unit 110 × 180 × 250 mm and of the column 1360 × 385 × 230 mm; weight of the unit 4.7 kg and of the column 35 kg. (OTS)

27278 REMOTE CONTROL IN NUCLEAR PLANTS. S. Barabaschi and C. Mancini (Comitato Nazionale Energia Nucleare, Ispra, Italy). Comit. nazl. energia nucleare, Notiz., 8: No. 1, 3-8(Jan. 1962). (RT/ING(62)5). (In Italian)

Problems of remote control in nuclear plants are outlined. The master-slave manipulator, known as MASCOT I, is described. (auth)

27279 DESIGN AND CONSTRUCTION OF A PHOTOGRAPHIC MACHINE WITH A ROTATING MIRROR. M. Martone (Comitato Nazionale Energia Nucleare, Ispra, Italy). Comit. nazl. energia nucleare, Notiz., 8: No. 2, 3-9 (Feb. 1962). (RT/FI(62)19). (In Italian)

The design and construction of a streak camera are described. The camera has a wide aperture (f/6.2) and a resolving time of 1 nsec. (auth)

27280 ELECTRONIC INSTRUMENTATION FOR NUCLEAR PHYSICS EXPERIMENTS. A. Mauti, B. Rispoli, and A. Serra (Comitato Nazionale Energia Nucleare, Ispra, Italy). Comit. nazl. energia nucleare, Notiz., 8: No. 3, 2-16(Mar. 1962). (RT/EL(62)12). (In Italian)

A system designed for resolving the various problems of electronic instrumentation connected with nuclear physics experiments is described. The system is of assembled-unit-type in order to achieve flexibility, automation of measuring with simple programming, and direct printing recording on tape or punched cards of experimental data. Each unit is designed having in mind absolute operating reliability. (auth)

27281 RADIATION-MEASURING SYSTEMS OF SOVIET ROCKETS. P. V. Vakulov, N. N. Goryunov, Yu. I. Logachev, and E. N. Sosnovets. Geomagnetizm i aeronomiya, 1: 880-7(Nov.-Dec. 1961).

The second and third Sputniks and all Soviet space rockets and spaceship-satellites were equipped with radiation-measuring systems comprising scintillation and gas-discharge counters and shaping, amplification, and scaling circuits. The scintillation counters use photomultipliers having either 40 × 40 NaI(Tl) or 20 × 20 CsI(Tl) cylindrical crystals. Both types have a gain of $\sim 5.10^4$. The high-voltage battery supplies voltages to the photomultipliers without the use of voltage dividers. Pulses from the 11th, 9th, and 8th dynodes are used for counting the number of particles which produce energy yields from the crystal exceeding ~50 and 500 kev and 5 Mev, respectively. Four-stage transistor amplifiers with an over-all gain of ~100 are used for amplification of the counting pulses. The trigger-discriminator, together with the amplifier, is capable of counting $(2.5 - 3.0) \times 10^5$ pulses/sec and of insuring a threshold stability of 10% at ambient temperatures of −30 to +50°C and voltage variations of ±20%. Ionization is measured from the current of the 7th dynode and the photomultiplier collector, which permits readings as low as 10^{-9} amp to be made by the method of charge storage (in the capacitor) with subsequent discharge through a neon tube. A gas-discharge counter with 50 mg/cm² stainless-steel walls, operating at 400 v, also measures ionization. Before coming to the scaling circuit, the 50 v negative pulses from this counter pass through a transistor amplifier which changes their polarity and reduces their duration to 8 to 10 μsec. (OTS)

27282 SCINTILLATION CHAMBER. Georges Charpak (Centre National de la Recherche Scientifique, Paris). Inds. atomiques, 6: 63-71(1962). (In French)

The scintillation chamber is an instrument which has assumed an increasingly important role in experiments made with high-energy accelerators. These instruments permit the spatial position of charged particles to be determined with very good time resolution. The various stages leading to the scintillation chambers being used are analyzed, and their principal characteristics are described. (tr-auth)

27283 WB COUNTERS. Pierre Wenger (Université Geneva). Inds. atomiques, 6: 93-7(1962). (In French)

The apparatuses capable of making an anthropogammametry or evaluation of the γ activity emitted by an entire organism are called WB counters. The history and characteristics of WB counters are described, and the areas of application are given. (tr-auth)

27284 THICKNESS MEASUREMENT WITH COMBINED β RADIATION SOURCES. G. Schuetz (Mitteilung aus dem VEB Vakutronik, Dresden). Isotopentechnik, 2: 129-31 (May 1962). (In German)

The measurement range of a thickness measurement device working with radiation depends on the isotope used. The measurement sensitivity is greatest at a surface mass $s = 1/\mu'$ (μ' is the mass absorption coefficient), and it decreases both at larger and at smaller surface masses. This disadvantage can be eliminated in various ways. It is theoretically possible, by simultaneous utilization of two or more different isotopes, to eliminate partially the unwanted dependence of the measurement sensitivity on the surface mass and to extend the measurement range. The difficulties in the technical realization of this method are discussed. (tr-auth)

27285 BASIC TYPES OF DIRECTION GAMMA DETECTORS AND THEIR USE IN MEDICINE. II. Štefan Hupka. Jaderná energie, 8: 149-55(1962). (In Czech)

A number of diagnostic and therapeutic methods based

on the use of radioisotopes are worked out. The description and arrangement of basic types of directional gamma detectors and their use in medicine are studied, with special attention to local diagnostics. (auth)

27286 LOW LEVEL COUNTING TECHNIQUES WITH SPECIAL REFERENCE TO BIOMEDICAL TRACER PROBLEMS. Fazle Hosain and B. D. Nag (Saha Inst. of Nuclear Physics, Calcutta). J. Exp. Med. Sciences, 3: 103-14 (Dec. 1959).

Low-level counting techniques in tracer experiments are discussed with emphasis on the measurement of beta and gamma radiations with Geiger and scintillation counting methods. The basic principles of low-level counting are outlined. Screen-wall counters, internal gas counters, low-level beta counters, scintillation spectrometers, liquid scintillators, and big scintillation installations are described. Biomedical tracer investigations are discussed. Applications of low-level techniques in archaeological dating, biology, and other problems are listed. (M.C.G.)

27287 NEW SCANNING TECHNIQUE FOR SMALL ANIMALS. J. Lafuma. J. Radiol., Electrol. Med. Nucl., 43: 408(June-July 1962). (In French)

A scanning technique is described for the localization of radioisotopes in small animals, such as rats. Difficulties encountered in counting low-level activities are reviewed. A relay system is described that eliminates background noise and increases the sensitivity of the scanner. (C.H.)

27288 PRECISE DETERMINATION OF THE RADIOACTIVITY OF A LIVING ANIMAL. J. Lafuma. J. Radiol., Electrol. Med. Nucl., 43: 409(June-July 1962). (In French)

The classical method for the determination of the body burden of the radioactivity of an animal, i.e. the daily determination of the difference between ingested and eliminated quantities, is subject to systematic errors. It is more valuable to determine directly the quantity of isotopes fixed by the animal, but radioactive determination necessitates a defined geometry and the variations of the internal localization of the radionuclide in the living animal make such a condition illusive. The error may reach 100%. A device is described that reduces the effect of such variations on the determination. The detector is a sodium iodide crystal, 10 cm in diameter. Below such a detector, the animal is placed within a cylinder 10 cm in length and 8 cm in diameter that turns around a horizontal axis. The rotation speed is of about one revolution/minute. The animal is placed in such a manner that any important movement becomes impossible. The determinations are made for a complete revolution or for an entire number of revolutions. In the case of pure sources, experience shows that there exists an optimum distance between cylinder and detector, so that the counting level is at ±2% independent from the position of the sources within the cylinder. (auth)

27289 LATEST DEVELOPMENTS OF MAGNETIC β SPECTROMETERS. L. Werner (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 5: 450-61(June 1962). (In German)

A survey is given of how the magnetic β spectrometers built in the last few years fulfill the requirements which must be placed on measurement devices for the clarification of the β and γ decay of radioactive nuclides. (tr-auth)

27290 ELECTRONIC MEASURING AND GUIDING SYSTEM OF A NEUTRON DIFFRACTION APPARATUS. H. Faatz and W. Klein (Frieske and Hoepfner GmbH, Erlangen, Ger.). Kerntechnik, 4: 148-50(Apr. 1962). (In German)

The electronic equipment of a neutron diffraction plant is described, comprising two digital measuring channels with electronic time control, using BF_3 counter tubes as detectors; and two electromechanical positioning systems for two goniometer arms. It is possible to print all results digitally registered (counting rate of measuring channels, time, position of goniometer arms) by means of a counted-result printer. This fully automatic plant is equipped with a preprogramming device. (auth)

27291 RADIATION MONITOR WITH SELF-CONTROL OF PROPER WORKING CONDITIONS. H. Mahnau (Labor für Kernphysikalische Messgeräte, Herfurth GmbH, Hamburg). Kerntechnik, 4: 156-7(Apr. 1962). (In German)

A gamma radiation monitor is described that gives a signal if an adjustable flux level is reached. Special arrangements safeguard against fail alarms. A self-control device indicates if proper working of the monitor is not guaranteed. The proper value of the measured background is used as the criterion for proper working and triggering readiness. (auth)

27292 MEASUREMENT AND OBSERVATION DEVICES FOR HIGH ENERGY PHYSICS. K. H. Reich. Kerntechnik, 4: 250-5(June 1962). (In German)

Engineering problems in the design and construction of nuclear counters, hydrogen bubble chambers, and apparatus for the evaluation of photographs taken with cloud chambers are described. (auth)

27293 ON THE OPERATIONAL CHARACTERISTICS OF A GAS FLOW COUNTER. C. H. Parekh (Atomic Energy Establishment, Trombay, India). Nuclear Instr. & Methods, 15: 213-21(Apr. 1962). (In English)

Experiments performed with the loop anode gas flow counters are discussed. Experiments were performed to study the dependence of threshold potential with the variations in source-anode distance and size of the loop. The results obtained with the variations in loop size indicated that there exists an optimum loop size for the minimum of the threshold potential. With a cylindrical chamber optimum radius of the loop obtained was r/3.33(r = radius of the counter). A systematic analytical investigation of the occurrence of the optimum loop size gave loop radius to be r/2.67. Another set of experiments was performed to reduce the difference between the results obtained between experimental observations and that of analytical investigation in which spherical counter was used so as to have a closer approach to the assumptions made in the analytical investigations. The results obtained gave optimum loop radius to be r/2.80. For the sake of interest loop was replaced by a thin copper disc. The variations in disc size did not indicate occurrence of any optimum disc size so as to give the minimum of the threshold potential. (auth)

27294 MULTICHANNEL AMPLITUDE ANALYZER OF THE "GREY WEDGE" TYPE. B. Schlenk (Inst. of Nuclear Research, Hungarian Academy of Science, Debrecen). Nuclear Instr. & Methods, 15: 231-2(Apr. 1962). (In English)

The simplification of analyzers of the "grey wedge" type is discussed. Omitting the optical grey wedge, the same effect can be produced by the application of a suitable modulating pulse fed to the grid of the cathode-ray tube. (auth)

27295 SPECTRUM EXPANDER FOR SEMICONDUCTOR DETECTOR SPECTROSCOPY. G. Fabri, E. Gatti, and V. Svelto (Centro Informazioni Studi Esperienze, Milan). Nuclear Instr. & Methods, 15: 237-42(Apr. 1962). (In English)

A method is suggested and an instrument is described allowing the detailed analysis of high resolution lines in semiconductor detectors spectroscopy with conventional instrumentation. The application of the method allows an amplitude measurement on a conventional pulse height analyzer

with a typical resolution, correspondent to the use of 4000 channels with an associated adequated stability. The method suggested is based on the ballistic amplification of the sum of two electrical charges injected at the input of a preamplifier; a first one released from the particle detected by the semiconductor detector and a second of opposite sign injected with a short delay by a standard charge generator. (auth)

27296 OZONE HAZARDS INCURRED BY ELECTRON VAN DE GRAAFF OPERATION. J. S. Loomis, I. T. Myers, H. V. Larson, and D. E. Wisehart (General Electric Co., Richland, Wash.). Nuclear Instr. & Methods, 15: 243-8 (Apr. 1962). (HW-SA-2283). (In English)

Solid state physics experiments employing radiations from a 2.0 Mev Van de Graaff electron accelerator resulted in the generation of significant quantities of ozone when liquid nitrogen was used as a cooling agent. Under experimental conditions the ozone produced proved to be an explosion and personnel exposure hazard for which suitable provision must be made. (auth)

27297 PULSE SHAPING AND STANDARDIZING OF PHOTOMULTIPLIER SIGNALS FOR OPTIMUM TIMING INFORMATION USING TUNNEL DIODES. Arthur E. Bjerke, Quentin A. Kerns, and Thomas A. Nunamaker (Univ. of California, Berkeley). Nuclear Instr. & Methods, 15: 249-67 (Apr. 1962). (UCRL-9838). (In English)

Accurate timing signals were derived from fast photomultiplier pulses by differentiating the photomultiplier pulse in order to produce a zero-crossing signal whose time of zero crossing is fixed over a large dynamic range of light level. Detection of the zero-crossing point is accomplished with a balanced-bridge tunnel-diode discriminator, which produces a standardized output of 100-mV amplitude, and a half-width of 4 nsec. A balanced bridge is used to prevent the zero-crossing signal from appearing at the output. For a twenty-to-one range of photomultiplier-input light level, the time shift of the output pulse may be as low as 0.5 nsec with a change in the output amplitude of less than a factor of two. When this discriminator is used with a 14-stage photomultiplier, the sensitivity is great enough to allow direct operation from single photo-electrons. These numbers are an indication of what could be obtained with the tunnel diode and transistor combination chosen at the time of the original development almost two years ago. Since that time, particularly in the tunnél-diode field, numerous improved devices have become available. These are being evaluated in zero-crossing circuits. The zero-crossing photomultiplier pulse was generated in two ways. The first method used an overdamped LC-tuned circuit built into the base of a 6810-A photomultiplier. Here the time of zero crossing was controlled by the frequency of the LC-tuned circuit. The decay time of the scintillation plastic used and the rise time of the photomultiplier determine what this zero-crossing time should be. A clipping stub was also used to produce the zero crossing remotely from the photomultiplier. By this method, the zero-crossing time can be controlled by both the length and impedance of the clipping stub. (auth)

27298 DEAD-TIME LOSSES WITH PULSED BEAMS. A. M. Cormack (Tufts Univ., Medford, Mass.). Nuclear Instr. & Methods, 15: 268-72(Apr. 1962). (In English)

Dead-time losses which occur in connection with pulsed beams differ from the losses which occur for continuous beams. Some statistical distributions are given which are useful for the calculation of the losses, and approximate formulas are given for some cases which arise frequently. (auth)

27299 A FOUR LITERS LIQUID HELIUM BUBBLE CHAMBER. E. Di Capua (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome), U. Dore, G. C. Gialanella, P. Guidoni, I. Laakso, and G. C. Moneti. Nuclear Instr. & Methods, 15: 273-81(Apr. 1962). (In English)

A helium chamber is described which has a useful volume of 4.2 liters. The chamber can be operated at 1 expansion per second in a magnetic field of 17 kgauss. The static liquid helium consumption is 1.6 l/h; the dynamic consumption is 4.3×10^{-4} liters per expansion. The variation with temperature of the sensitivity to minimum ionizing particles is shown. (auth)

27300 WEAK LENS FORMULAS FOR ACCELERATING TUBES. Minoru Morikawa (Nissin Electric Co., Ltd., Kyoto). Nuclear Instr. & Methods, 15: 282-7(Apr. 1962). (In English)

For the design of the accelerating tubes in the high voltage Cockcroft Walton accelerator, the weak lens formulas are simple and convenient. The weak lens formulas in the relativistic and non-relativistic cases are given in powers of the small parameter $\epsilon = (\Phi_2 - \Phi_1)/(\Phi_2 + \Phi_1)$ for the two-cylinder lens with axial potential by Kirkpatrick and Beckerley, together with a summary of the results for other two-cylinder lenses with typical axial potentials. The weak lens formulas were compared with those of several authors and shown to be good approximations. The relativistic weak lens formulas in connection with the accelerating tubes of the Cockcroft Walton electron accelerator of 2 MV rated voltage are also given. The results of the numerical calculations of the beam paths by using these formulas are shown. (auth)

27301 A DOUBLE PROPORTIONAL COUNTER FOR ABSOLUTE MEASUREMENTS ON LOW ENERGY PHOTONS AND ELECTRONS. P. Kramer, J. de Ridder, and J. Blok (Universiteit, Amsterdam). Nuclear Instr. & Methods, 15: 289-96(May 1962). (In English)

A method is described for absolute counting of x radiation and Auger electrons. The construction of a double proportional counter, consisting of two adjacent counters with a square cross section, is outlined. The sources are placed in the wall between the two counters. The source backing is a thin (2 $\mu g/cm^2$) formvar foil, made conductive by a layer of silver with a thickness of 8 $\mu g/cm^2$. Absolute counting of Auger electrons with energies higher than 5 kev and of x rays with energies lower than 12 kev is realized. (auth)

27302 A BALANCED IONISATION CHAMBER FOR ACCURATE BEAM LOCATION. A. J. Metheringham and T. R. Willitts (University College, London). Nuclear Instr. & Methods, 15: 297-9(May 1962). (In English)

A description is given of a balanced ionization chamber for use as a sensitive and stable monitor of the position of a position of a proton beam in polarization experiments. It is noted that, when used with a solenoid producing spin reversal, this type of detector does not necessarily completely eliminate false asymmetries. (auth)

27303 EFFICIENCY OF A LONG COUNTER AS A FUNCTION OF THE DIRECTION AND LOCUS OF INCIDENCE OF THE NEUTRON. E. Landim, E. W. Hamburger, and O. Dietzsch (Universidade, São Paulo, Brazil). Nuclear Instr. & Methods, 15: 300-5(May 1962). (In English)

The efficiency of a shielded and of an unshielded Hanson-McKibben long counter is measured as a function of the position and direction of incidence of the neutron on the front face of the paraffin cylinder. A collimated neutron beam from a Ra-α-Be source is used for the measurements. The efficiency of the long counter in an approxi-

nately uniform flux of Ra-α-Be neutrons is also measured, as a function of the angle made by the counter axis and the flux direction. (auth)

27304 MASS DISCRIMINATION WITH PLASTIC SCINTILLATORS. R. J. Griffiths (N.I.R.N.S., Harwell, Berks, Eng.), K. M. Knight, C. J. Candy, and A. J. Cole. Nuclear Instr. & Methods, 15: 309-14(May 1962). (In English)

Mass discrimination of protons, deuterons, and tritons is shown to be possible from 8 to 50 Mev, by obtaining a suitable product of the outputs of dE/dx and E plastic scintillation detectors in a counter telescope. The non-linear energy response of the scintillator NE102 is taken into account in the calculation of the function that gives optimum mass discrimination over this energy range. A transistor circuit that performs the computation of this function is described, together with its characteristics and performance. (auth)

27305 AN ELECTRICAL DELAY CIRCUIT. L. Wåhlin and E. Blignaut (National Physical Research Lab., C.S.I.R., Pretoria). Nuclear Instr. & Methods, 15: 315-17(May 1962). (In English)

The circuit of a delay element with characteristics comparable to those of commercial delay cables such as RG65U is presented. Advantages are: no necessity for impedance matching; no echoes; and small dimensions when transistors are used. The circuit can be used in pulse counting equipment for pulse clipping and coincidence purposes. (auth)

27306 LOCATION OF THE POSITION OF A SPARK IN A SPARK CHAMBER. G. Charpak (CERN, Geneva). Nuclear Instr. & Methods, 15: 318-22(May 1962). (In English)

With special electrodes having the structure of a distributed delay-line, it is shown that by measuring the delay between the arrival of the signals following a spark at two opposite ends of the electrodes, the initial position of the spark can be determined. A spark chamber with electrodes giving a delay of 0.2 msec is constructed. (auth)

27307 LOCATION OF THE POSITION OF A PARTICLE TRAJECTORY IN A SCINTILLATOR. G. Charpak, L. Dick, and L. Fouvrais (CERN, Geneva). Nuclear Instr. & Methods, 15: 323-6(May 1962). (In English)

Light pulses traveling in opposite directions in a flat scintillator are collected by two photomultipliers. The delay between the arrival of the two pulses, measured with a time-converter, gives the position of the traversal of the scintillator by an ionizing particle. It is found that the average propagation speed of the light in the scintillator is 10^{10} cm/sec. The relation between position and delay is linear along the axis of a 40-cm-long scintillator. The accuracy (full width at half height) in the determination of the position is 5 cm with a collimated strontium source. Possibility of eliminating the fluctuations introduced in time-of-flight measurements with extended scintillators is discussed. Addition of the pulses from the two photomultipliers eliminates to a great extent the variation of pulse height as a function of the position of the ionizing particle. The variation is less than 10%. (auth)

27308 THRESHOLD DETECTORS FOR MEASURING FAST NEUTRON SPECTRA. R. Dierckx (Studiecentrum voor Kernenergie, Mol, Belgium). Nuclear Instr. & Methods, 15: 355-6(May 1962). (In English)

A threshold-detector method for measuring neutron spectra from 0.5 to 14 Mev is presented that is based on the assumption that the spectrum in any small, definite energy interval may be represented by the exponential function $\Phi(E) = A \exp(-kE)$. The energy intervals and threshold reactions used are: 0.5 to 2 Mev, $In^{115}(n,n')$; 2 to 4.5 Mev, $S^{32}(n,p)$; 4.5 to 6 Mev, $Fe^{56}(n,p)$; and 6 to 14 Mev, $Al^{27}(n,\alpha)$ and $Rh^{103}(n,2n)$. In a sample calculation on a fission spectrum, the method gives an accuracy of 2% for the total number of neutrons in a given energy interval relative to the other intervals, although the spectrum considered deviates by more than 10% from the exponential $\Phi(E)$ function. As a result of the technical difficulties encountered with the Rh detector, the spectrum above 6 Mev may be alternatively calculated theoretically. (T.F.H.)

27309 CONSTRUCTION OF A SAMPLE CHANGER BASED ON THE GENEVA WHEEL PRINCIPLE. H. Moret (Common Research Center (EURATOM), Geel, Belgium). Nuclear Instr. & Methods, 15: 357-9(May 1962). (In English)

A sample holder is described that contains four sample cells, each of which is to be irradiated separately. The change from one cell to the next is performed automatically after a predetermined number of counts is registered by the counting circuitry. The holder is in the form of a cross having four identical arms and four right angles, with the sample cells placed in identical positions near the ends of the arms. The holder rotates axially; mounted rigidly on its axis of rotation is a "Geneva" cross having four slotted arms. A motor is provided, with a stud that fits into the slots in the cross arms. As the stud rotates, it engages the slot and rotates the cross and holder. A full rotation of the motor and stud causes the holder to rotate exactly 90°. (T.F.H.)

27310 A SLIDE RULE FOR MAKING DEAD TIME CORRECTIONS. J. H. Scott (Grand Junction Operations Office, AEC). Nucleonics, 19: No. 9, 90; 92(Sept. 1961). (RME-130)

The formula $N = n/(1 - nt)$ may be used to correct the observed counting rate of a radiation detector for pulses that are lost during the instrument's dead time, where N is the corrected counting rate, n is the observed counting rate, and t is the dead time. A circular slide rule is designed, which permits rapid solution of this formula for a wide range of counting rates and dead times. (T.F.H.)

27311 ENERGY DETERMINATION OF β AND γ RADIATION IN LIQUID SCINTILLATORS. Traude Cless-Bernert, Klaus E. Duftschmid, and Herbert Vonach (Institut für Radiumforschung und Kernphysik, Vienna). Nukleonik, 4: 162-5(June 1962). (In German)

A simple method for the energy calibration of liquid scintillators is described. By correlation of the energy of the Compton edge to the half-value of the curve of the Compton spectrum, a straight line going through the coördinate origin and extending over the entire measured energy range was obtained. For the calibration, twelve different γ lines with energies from 0.1 to 2.5 Mev were used. The validity of this energy correlation was tested by means of the Curie diagrams of P^{32}, S^{35}, Y^{90}, and Tl^{204}. The values obtained for the maximum β energies agree from 1 to 2% with the known values. The theoretical assumptions are discussed. The method necessitates no corrections for the resolving power of the scintillator or for scattering and absorption of β rays and is very suitable for the convenient energy determination in β spectroscopy with liquid scintillators. It can also be applied when the sample to be measured is dissolved in the scintillator liquid. (tr-auth)

27312 THE MECHANISM OF CORONA-LESS SPARK COUNTER WITH INHOMOGENEOUS ELECTRIC FIELDS. Hahns-Joachim Belitz (Universität, Giessen, Ger.). Nukleonik, 4: 175-80(June 1962). (In German)

A simple model representation for the counting and discrimination behavior of corona-less counters with inhomogeneous electrical fields was developed. The counting and discrimination properties depend on the electrical field distribution in the counter. The qualitative agreement between theory and experiments was shown. A series of observations on spark counters can be explained with this representation. The efficiency limit of the model was shown. (tr-auth)

27313 TRAJECTOGRAPHS--AUTOMATIC DEVICES FOR COMPUTING AND CONSTRUCTING CHARGED PARTICLE TRACKS. G. E. Levin and G. P. Prudovskii. Pribory i Tekh. Ekspt., 7: 7-19(1962). (In Russian)

Automatic computers for calculating and developing trajectories of charged particles moving in an electromagnetic field are described. The resolution is derived by developing trajectories either along the curvature radius or along the deflection angle tangent at given points (calculation of natural coordinate system) or by integration of forces acting on the particle in a projection of a fixed coordinate system axis. (tr-auth)

27314 MEASUREMENTS OF γ-QUANTUM RESONANCE ABSORPTION SPECTRA IN CRYSTALS. V. A. Bryukhanov, N. N. Delyagin, B. Zvenglinskii, S. A. Sergeev, and V. S. Shpinel (Inst. of Nuclear Physics, Moscow State Univ.). Pribory i Tekh. Ekspt., 7: 23-8 (1962). (In Russian)

A design is given of a device for determining the magnitude of γ resonance absorption (Mössbauer effect) in crystals. The device is based on the output pulse amplitude modulation coincident with relative source and absorber velocity variations. The device is capable of simultaneous measurements of the total absorption spectrum in a wide range of velocities. Resonance absorption of 2.8 kev γ quanta by Sn^{119} in an SnO_2 crystal was analyzed. (tr-auth)

27315 PHOTOGRAPHY OF PARTICLE TRACKS USED FOR SIMULTANEOUS ENERGY AND IONIZATION MEASUREMENTS IN LARGE WILSON CHAMBERS. M. I. Devishev, D. F. Rakitin, and S. V. Ryabikov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 7: 28-32(1962). (In Russian)

The equations are derived and verified for selecting optimum photographic conditions in large Wilson chambers for measuring particle energy and ionization at >1 Bev. (R.V.J.)

27316 CONSIDERATION OF FINITE CHAMBER DIMENSIONS IN STUDYING NUCLEAR PROCESSES. N. N. Mel'nikova (Joint Inst. of Nuclear Research, Dubna, USSR). Pribory i Tekh. Ekspt., 7: 32-6(1962). (In Russian)

An analytical function was developed for recording distribution probabilities for secondary particle tracks formed in nuclear processes in a chamber. It was postulated that tracks of secondary particles can be found in any part of the chamber and the angular distribution in relation to the primary beam can be approximated by the function $A \cos^2 \theta + B \cos \theta + C$. The formula can be used for propane bubble chambers. (tr-auth)

27317 DENSITY DISTRIBUTION IN DIFFUSION CHAMBERS. A. P. Andreev and N. V. Dushin (Inst. of Physics and Technology, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 7: 37-40(1962). (In Russian)

Diffusion chamber performance with methyl alcohol in hydrogen at 100 atm pressure was analyzed, and the condensing vapor distribution in the chamber was determined. (tr-auth)

27318 A DEVICE FOR AUTOMATIC SCANNING OF NUCLEAR PHOTOEMULSION BY MEANS OF TELEVISION RASTER. II. Recording System. (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 7: 42-9 (1962). (In Russian)

The operational principles and interactions of various recording points of a device used for measuring multiple scattering and ionization along fast, heavy-particle tracks were studied. Aspects of precision and stability are discussed. The device is capable of measuring multiple scattering along tracks of particles with various energies at a rate of 200 μ/sec and ionization at 100 μ/sec. (tr-auth)

27319 CHARACTERISTICS OF SPARK CHAMBERS. A. A. Borisov, B. A. Dolgoshein, B. I. Luchkov, L. V. Reshetin, and V. I. Ushakov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 7: 49-54(1962). (In Russian)

Characteristics of argon-filled pulse-triggered spark chambers are given. The spark chamber exhibited a 100% efficiency in recording charged particles in a wide range of intensities. The chamber discharges follow tracks of ionizing particles with angles of incidence up to 35°. (tr-auth)

27320 RECORDING OF NEUTRONS FROM PULSED SOURCES. G. E. Marguliya, A. A. Plyutto, and I. M. Rozman. Pribory i Tekh. Ekspt., 7: 54-5(1962). (In Russian)

A method is suggested for measuring the time distribution and the integral yield from a (d-d) pulsed source with a scintillation spectrometer without a preamplifier. (R.V.J.)

27321 DETERMINATION OF SCINTILLATION COUNTER RESOLVING POWER. Yu. A. Tsirlin, V. A. Shvets, and Yu. K. Khudenskii (All-Union Inst. of Scientific Research on Monocrystals, Scintillation Materials and Pure Chemical Elements, USSR). Pribory i Tekh. Ekspt., 7: 56-7(1962). (In Russian)

An attempt is made to establish a relation between two methods for determining the resolving power of a spectrometer: the method using the curve of $n(\nu)$ pulse distribution for the photopeak from Co^{60} γ rays and determining the relation of the half-width of the photopeak to its abscissa $R = (\Delta\nu/\nu)$ 100% or the method of comparing photopeaks $E_1 = 1.17$ Mev and $E_2 = 1.33$ Mev for Co^{60} γ rays with the minimum depth between them. The relation between the ratio of the peak $E_2 = 1.33$ Mev to the ordinate of the minimum curve $n(\nu)$ for Co^{60} and the R_{Cs} resolution for 1.3 Mev γ rays was found. The calculations did not consider the background and the drop in the Compton continuum near the minimum between photopeaks. (R.V.J.)

27322 LARGE CHERENKOV DETECTOR FOR COSMIC RAYS. V. L. Dadykin (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Ekspt., 7: 60-2(1962).

Descriptions are given of a Cherenkov detector with a recording area of ~15 m^2 and a mean particle track in water of ~3 m. The results of tests on the detector are analyzed. The detector was used with a hodoscope system and Wilson chamber for studying wide atmospheric showers. (R.V.J.)

27323 LIGHT COLLECTION IN CHERENKOV DETECTORS. A. P. Onuchin and A. G. Khabakhpashev. Pribory i Tekh. Ekspt., 7: 63-4(1962). (In Russian)

Measurements of light collection in ϕ60 and 90 mm cylindrical Cherenkov counters designed for measuring ~100 Mev electrons showed for the ϕ90 mm detector, with complete intrinsic reflection, a light collection coefficient

of 30% in the center and 8% at the edges; the light collection coefficient reached 43% in the center and 25% at the edges with detectors with diffusion reflectors. However, ϕ40 and 90 mm detectors with total intrinsic reflection equipped with photomultipliers and large photocathodes reached 90% light collection in the center with a pulse amplitude distribution half-width of 32%. The electron beam passed through the counter center at all angles. At 70° the pulse amplitude was cut in half. (R.V.J.)

27324 256-CHANNEL TIME ANALYZER WITH A MEMORY DEVICE. A. P. Tsitovich (Inst. of Nuclear Energy, Academy of Sciences, USSR). Pribory i Tekh. Eksp., 7: 65-77(1962). (In Russian)

A design is given of a 256-channel time analyzer for neutron time-of-flight spectrometers. The analyzer is operated with an accelerator or automatic neutron selector. The memory installation is equipped with a magnetic drum. Four two-beam electron tubes are utilized for pulse selection and intermediate memory. The minimum channel width is 0.5 μsec. Accumulated data are read from the tube screen either in binary or linear form or from decade scales. (tr-auth)

27325 MATRIX TIME ANALYZER WITH STORAGE CAPACITY COMMUTATORS. A. P. Tsitovich and S. K. Sotnikov (Inst. of Nuclear Energy, Academy of Sciences, USSR). Pribory i Tekh. Eksp., 7: 78-85(1962). (In Russian)

Descriptions are given of a 160-channel matrix time analyzer for an automatic neutron selector designed with two storage switches and a diode coincidence scheme. The analyzer is operated with channel widths from 2 to 128 μsec. (tr-auth)

27326 PULSE HODOSCOPE FOR STUDYING μ MESON DECAY. B. A. Dolgoshein, B. I. Luchkov, and V. I. Ushakov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekh. Eksp., 7: 85-9(1962). (In Russian)

A hodoscope with pulse-excess gas-discharge counters for recording particle trajectories in $\mu \rightarrow e$ decay is described. (R.V.J.)

27327 HALL EFFECT PULSE MULTIPLIER FOR CHARGED PARTICLES. B. V. Gavrilovskii, K. V. Karadzhev, and A. Ya. Kislov (Inst. of Atomic Energy, Academy of Sciences, USSR). Pribory i Tekh. Eksp., 7: 90-4(1962). (In Russian)

A device was designed for analyzing charged particles up to ~10 Mev by multiplying microsecond pulses by means of the Hall effect in semiconductors. The device has a wide dynamic range of magnitudes and is capable of analyzing the charge and mass of secondary nuclear particles. (tr-auth)

27328 ENERGY MEASUREMENTS OF PAIRED FISSION FRAGMENTS. V. N. Dmitriev, L. V. Drapchinskii, K. A. Petrzhak, and Yu. F. Romanov (Radium Inst., Academy of Sciences, USSR). Pribory i Tekh. Eksp., 7: 94-6 (1962). (In Russian)

A method is suggested for simultaneously recording paired pulse amplitudes. Fragments from a screened double ionization chamber are shaped on short-closed lines. The pulses formed retain a plateau for several microseconds. The pulses from one channel are transmitted to a horizontal and from the other channel to a vertical deflecting plate in a single-beam electron tube. The illumination initiated by one of the fragment bursts coincides with the plateau of the recorded pulse. The flash point on the screen corresponds to a pair of pulses, and the distance from the vertical and horizontal axes is determined by the first and second pulse amplitudes. (R.V.J.)

27329 TEMPERATURE STABILIZER FOR THE MASS SPECTROMETER EFFUSION CHAMBER ION SOURCE. T. P. Georgobiani (Moscow State Univ.). Pribory i Tekh. Eksp., 7: 133-6(1962). (In Russian)

A temperature stabilizer for the range 400 to 1200°C was designed for ion source effusion chambers. The temperature control uses a platinum-platinum rhodium thermocouple and is reliable to within ±0.5°C. (tr-auth)

27330 PROTON DETECTOR WITH FILM CATHODE. V. A. Ergakov and Yu. V. Trebrikhovskii. Pribory i Tekh. Eksp., 7: 158-9(1962). (In Russian)

A proton detector with a polyvinylchloride, silver coated film cathode was designed for recording low-energy protons in heavy-ion and γ backgrounds. Under identical conditions the film detector is 100-fold less sensitive to background than electron multipliers. In a γ field of 100 μc/sec the detector counts ~2 pulse/sec. (tr-auth)

27331 ON THE IONIZATION MEASUREMENTS AND THE PROCESS OF TRACK FORMATION IN NUCLEAR EMULSIONS. A. P. Sharma and P. S. Gill (Muslin Univ., Aligarh, India). Proc. Natl. Inst. Sci. India. Pt. A, 28: 166-90(Jan. 26, 1962). (In English)

Track formation by an ionizing particle in a nuclear emulsion is considered. Assuming a random distribution of grains in G-5 emulsions, a theoretical relation was established for calculating the probability of development of a grain which depends on the characteristics of the emulsion and that of the charged particle producing the track. The experimental verification of the results was done by measuring long gap lengths on identified tracks in G-5 emulsions exposed to cosmic radiation. The results support the mechanism of recombination and track formation and explain the experimental curves of grain density vs. specific energy loss. (auth)

27332 A GAMMA-TOPOGRAPHER. Radio, No. 10, 22(1961).

A gamma-topographer, which permits the quick location of a malignant tumor in the body and has the property of absorbing radioactive isotopes, is described. A scintillating counter scans the body of the patient over an area 250 × 350 mm at a time. A special recorder prints dots on ordinary paper, the number of which per unit area is proportional to the intensity of radiation from the patient's body. The intensity of radiation permits the evaluation of the degree of isotope concentration and consequently the location of the malignant tumor. The gamma-topographer operates automatically, with the sensing device moving along the body surface always at the same distance. The scanning speed may vary between 0.5 and 10 mm/sec in steps from 4 to 20 mm. (OTS)

27333 MEASUREMENTS AND ANALYSIS OF RADIOACTIVITY. V. V. Artem'ev. Radiokhimiya, 4: 211-15(1962). (In Russian)

Data recorded by a counter in the presence and absence of background, and the utilization of this information for determining the performance of the measuring apparatus and for comparing various types of measurement are discussed. (R.V.J.)

27334 ABSOLUTE MEASUREMENTS OF WEAK NEUTRON FLUXES. G. V. Gorshkov, A. N. Silant'ev and O. S. Tsvetkov. Radiokhimiya, 4: 244-7(1962). (In Russian)

Absolute measurements of weak neutron fluxes were achieved by activated manganese. A scintillation gamma counter calibrated to 4-π beta-gamma coincidences was used for measuring the absolute activity of Mn^{56}. (R.V.J.)

27335 NEW RADIATION MEASURING APPARATUS. Telefunken Ztg., 33: No. 127, 4p. (Mar. 1960). (In German)

The radiation meter supply program of Telefunken has been extended considerably during the past year, presenting the following new equipment types: (1) Digital Autoscaler MsStr 610/1, an all-purpose equipment with high voltages up to 5 kilovolts. The equipment can be connected to all conventional radiation detecting meters and is fit for fully automatic operation when using a sample changer and time printer. (2) Three types Geiger-Mueller counter tubes. These probes contain halide counter tubes and are being used either for measuring gamma rays only or for taking measurements of alpha rays, gamma rays, as well as hard and soft beta rays. (3) Three types of scintillation probes with photo multipliers of differing diameters. Depending on the scintillator in use, these probes permit an examination of alpha, beta, and gamma rays, and of roentgen rays and neutrons. (4) Three lead-shields, with shields 2 to 3 inches strong, for standard and well-type crystal probes. (5) Sub-chassis assemblies such as amplifier, pulse height selector, etc. (auth)

27336 A DIGITAL RADIATION MEASUREMENT APPARATUS FOR GEIGER-MUELLER COUNTING TUBES. H. Brueckner and K. Fraenz. Telefunken Ztg., 33: 324-30 (Dec. 1960). (In German)

The Scaler Ms Str 473/1 was developed for measurements with self-quenching Geiger-Mueller counter tubes. It satisfies requirements for higher than those generally stipulated for precision measurements with Geiger-Mueller counters. In general these requirements refer to high HT stability over a lengthy period, that shall be reached even under strong mains fluctuations, a resolution adapted to Geiger-Mueller counters, and sensitivity. During practical design, solutions were sought that employ a minimum of tubes and other components and of which high reliability may be expected. The equipment circuitry is explained and the fundamental ideas set forth, measuring methods for checking the equipment properties are described in detail, and useful hints for using the equipment and the employment of accessories given. (auth)

27337 NEW RADIATION MEASURING APPARATUS. Telefunken Ztg., 34: No. 132, 4p. (1961). (In German)

A short description is given of instruments marketed since the last review has been published in the Telefunken-Zeitung (Vol. 33(1960) No. 127, P.65). The fully transistorized area monitor MS RÜ 729/1 permits radiation monitoring of buildings and plants by means of scintillation, GM, and neutron detectors. The logarithmic scale extends over 3 decades. Four ranges can be chosen, their full scale readings lying between 10^3 and 10^6 ppm. As soon as the activity becomes higher than a predetermined value or lower than a minimum value chosen, a signal is given. The automatic sample changer MS AP 731/1 is preferably used for activation analyses in conjunction with our pulse height analyzer MS Str 531 or the automatic scaler MS Str 610 and a time printer. It is designed for the use of 3 or 6 planchets and can be equipped with a lead shield. It has been made gasproof for windowless measurements with gas flow counters. Fully automatic activity measurements can be made by the automatic scaler MS Str 610 together with the time printer MS ZD 696/1. By means of the preset timer MS SU 697/1 and the utility scaler MS Str 473 semi-automatic preset time measurements can be carried out. The preset time interval is visible at any time and can be reproduced by pushing a button. For measuring soft β-rays emitted by nuclides as, e.g., tritium or C^{14} gas analyses counter tubes are highly efficient detectors. Due to the high input sensitivity and high voltage of our automatic scaler MS Str 610 those counter tubes can be connected without any further electronics. An automatic scaler with gas analyses counter tube and holder MS PZ 783/1 is shown. The distributed amplifier was designed for amplifying pulses in the millimicrosecond range. It is equipped with 6 tubes and attains a voltage gain of 20 db at a band width of 160 mc and an impedance of 100 ohms. Telefunken supplied a neutron time of flight analyser to the nuclear reactor station of Geesthacht. The mainly transistorized equipment analyses time intervals with a resolution of 0.1 microsecond. Every time interval corresponds to a channel of a ferrit core memory. As a whole 4096 channels with a capacity of 65,536 per channel are available. During the measurement the contents of the memory are displayed on an oscilloscope and can afterwards be read out by means of a printer or an xy-recorder. (auth)

27338 QUALITATIVE AND QUANTITATIVE GAMMA ANALYSIS OF LOWER ACTIVITIES BY THE GREY WEDGE METHOD. R. Tzschaschel. Telefunken Ztg., 34: No. 133, 10p. (Sept. 1961). (In German)

The Telefunken Pulse Height Analyzer MS Str 531 is an equipment combining a customary single-channel system with a grey-wedge analyzer (produced commercially for the first time). The grey-wedge method supplies results quite comparable with those of four-channel spectrometry, which is described. Comparative measurements between the single-channel and the grey-wedge method are discussed. The samples measured are total solids from rain water and some soil samples from the vicinity of the nuclear research center at Jülich. All samples had a very low activity. Particularly striking are the great differences in the measuring time in the two methods and the much higher content of information provided by the grey-wedge spectra, which can even be recognized at the shortest exposure time of half an hour. The latter is quite understandable because in principle the grey-wedge spectrum is a multi-channel spectrum produced with optical means. A table gives a summary of the fallout nuclides ascertained in the grey-wedge spectrograms. The evaluation of the grey-wedge spectrograms, i.e., the calibration of the energy axis and a suitable method of printing the spectrum, is described. A family of calibration curves that were measured using various samples is shown. If grey-wedge spectra are to be printed in a scientific publication it is recommended, for reasons of clarity, to print the energy scales with arrows pointing to the nuclides determined. The so-called "equi-density method" permits representing the grey-wedge spectrum as a kind of written single-channel or multi-channel spectrum. The calibration of the activity axis of a grey-wedge spectrum is described. Calibration was effected with the iodine isotopes I^{131} of which various samples at different activities were available. Grey-wedge recordings were made and the height of the gamma lines measured. In the semi-logarithmic scale the results obtained in this manner show strict linearity between the activity and the height of the gamma lines. As regards estimating the accuracy of energy and activity calibrations, the following should be mentioned in conclusion: in principle handling the grey-wedge spectrometer necessitates highly accurate photography, to which the physicist is accustomed from spectrum optics. If this accuracy is given, then the energies of unknown nuclides and the activities of definite nuclides can be ascertained with an accuracy of approximately 3 to 5%. (auth)

27339 STABILIZATION OF PULSE AMPLITUDE IN FEEDBACK AMPLIFIERS. K. Fraenz and H. Pauckert. Telefunken Ztg., 35: No. 135, 14p. (1962). (In German)

If the amplification factor μ alters by the small amount

$\Delta\mu \ll \mu$ because the tube transconductances or current amplifications of transistors change, the output voltage $u_t(t)$ of the amplifier fluctuates: this fluctuation, the error voltage $\Delta u_t(t)$ can be divided into a stationary component that represents the stabilization of the output voltage on slow voltage fluctuations, and a component decreasing with time which describes the building-up of the stabilization. The smaller the relative change $\Delta u_a/u_a$ of the output voltage in respect of the relative amplification change $\Delta \mu/\mu$ which would result without negative feedback, the better is the stabilization of the output voltage. At the beginning $t = 0$ of the pulse, $\Delta u_a/u_a$ is equal to $\Delta \mu/\mu$, i.e., stabilization by negative feedback is still ineffective irrespective of how good the stabilization $(1 + \mu\beta)^{-1}$ is made for slow voltage fluctuations. If stabilization building-up time means the time which must elapse until the time-dependent component $(\mu\beta/1 + \mu\beta)\sigma(t)$ of the relative error voltage $\Delta u_a/u_a$ drops to the value $(1 + \mu\beta)^{-1}$ of the stationary component, then the following rule applies: in amplifiers free of overshooting with the same transient time T_θ, approximately equal times are required for stabilization build-up at equal input voltages, i.e., approximately the same values of $\sigma(t)$ irrespective of whether the amplifier design is more or less complicated. σ is calculated and graphically presented for some typical input voltages. It is shown that with customary negative feedbacks $10 < \mu\beta < 100$ times t of the approximate magnitude $2\ T_\theta < t < 3\ T_\theta$ elapse until $\sigma(t)$ has dropped to the value $(1 + \mu\beta)^{-1}$ of the stabilization for slow transits. $\sigma(t)$ is shown for voltage steps and square-wave pulses, for voltage rises of finite rise time T_1, and for pulses. (auth)

27340 NEW RADIATION MEASURING APPARATUS. Telefunken Ztg., 35: No. 135, 4p. (1962). (In German)

The Anti-Coincidence Measuring Probe MS GMAk 591/1 can be used to great advantage in the measuring of very low beta activities. By the employment of the guard counter principle in conjunction with a mercury lead shield, a background counting rate of only 1.3 to 1.4 pulses/min is obtained. The large Mercury Lead Shield MS QB1 a 733/1 permits activity measurements and the spectroscopy of radioactive samples of low activity. The shield reduces the interfering background which a radiation detector produces under the influence of ambient radiation and cosmic rays. The radiation detector and the sample to be measured are arranged inside the shield and thus only a small fraction of the radiation reaches the detector. Substantially the large mercury lead shield comprises an external lead shield about 50 mm thick and an internal mercury shield about 20 mm thick. The characteristic radiation of the long-life lead isotope Pb^{210} and its daughters are kept away from the detector by the internal mercury shield. The Manual Sample Changer MS HP 730/1 is an accessory for the Methane Flow Counter MS MD 632. Changing the samples in the methane flow counter can be greatly simplified by the use of the manual sample changer. Opening and closing the counter chamber of the methane flow counter by means of the screwed lid is avoided when the manual sample changer is used. (auth)

27341 THE TELEFUNKEN CHAIN AMPLIFIER MS KtV 590/1. H. Paucksch. Telefunken Ztg., 35: No. 135, 6p. (1962). (In German)

The Distributed Amplifier MS KtV 590/1 is intended primarily for pulse amplification and possesses an inherent rise time of <3 nsec at 20 db gain. Due to the use of the high μ pentode E 180 F, only six amplifier tubes are required. It is impossible to use tubes of even higher transconductance because they all have a higher input capacity. The grid filter network with the prescribed cut-off frequency cannot be realized with such input capacities. For use as a pulse amplifier it is essential that the group delay time is adequately stable in the transmission range. The delay is calculated for a filter network at various values L_q. It can be seen that negative inductances L_q must be used to obtain a satisfactory behavior. In practice these negative inductances can be obtained by mutual coupling of the inductances L. The deformation of a pulse in a filter network which is inadequately compensated is shown. A further improvement of the filter section can be obtained with a circuit which would provide also the advantage of a characteristic impedance independent of frequency when the bridging capacity is suitably selected. The circuit cannot be realized for frequencies at about 100 Mc/s, but the properties of a filter section approach those of the bridged T closely due to the winding capacities which are always present. In the distributed amplifier described, this possibility was exploited. Corresponding oscillograms of pulses on the grid filter network and their transfer to the anode filter network can be seen. The amplification and group time for the entire amplifier and the circuit diagram of the unit are shown. The measured output and input pulses of the amplifier are shown, the inherent rise time of the oscilloscopes being 0.7 nsec. From four distributed amplifiers in cascade that still operate stably, output pulses with a rise time less than 6 nsec are obtained, and due to the high amplification the noise of the first amplifier (approx. 70 μv peak to peak referred to the input) can already be seen in the oscillogram. (auth)

27342 CHARACTERISTICS OF THE PULSE FROM SCINTILLATION PROBES WITH NaI(Tl) CRYSTALS. K. Fraenz and Kl. Mueller. Telefunken Ztg., 35: No. 135, 16p. (1962). (In German)

An outline is given of theoretical and experimental investigations of the properties of scintillation pulses generated by probes containing NaI(Tl) crystals. Particular attention is paid to the pulse statistics by which the simultaneously obtainable energy and time resolution of the gamma spectrometers which operate with these crystals is determined. At first the current pulses at the collector of the photo multiplier are investigated by means of the known elementary equation. It follows that at low time constants ϑ the optimum time resolution is approximated which is determined by the time constant τ of the scintillator. For some Harshaw NaI(Tl) crystals $\tau \sim 200$ nsec were ascertained, i.e., somewhat shorter times than generally given. The measurements show that for $\vartheta \geq \tau$ the time t_m of the maximum $\hat{u}$ of the voltage pulse and the amplitude $\hat{u}$ may be calculated in spite of the statistic variation of the pulses, the delay time distortions of the multiplier, and other deviations of the collector current from the simple exponential law. Careful measurements of the line width show that the line width does not noticeably depend on ϑ for time constants $\vartheta \geq \tau$, in good probes in any case. In view of the inherent contribution of the crystal to the line width, discovered by Kelley, this is understandable. In order to separate the influence of the time averaging on the line width from the contribution of the crystal which is scarcely influenced by averaging over single pulses, a coincidence test was carried out. In this test a spectrometer selects at a fixed channel position from the pulses of a photopeak originating from a probe, the pulses with a fixed total charge by averaging with time constants $\vartheta_1 \gg \tau$, while a second spectrometer averages with arbitrary values ϑ_2 over partial charges of the same pulses. The coincidence experiment permits the quantitative measure-

ment of the influence of the time constants ϑ, and confirms, as was expected, that there is only a slight influence of the time constants ϑ on the over-all line width up to values $\vartheta \sim \tau$. (auth)

27343 COUNT-RATE METERS WITH LINEAR AND LOGARITHMIC SCALES. G. Boucke. Telefunken Ztg., 35: No. 135, 10p. (1962). (In German)

A description is given of counting rate meters preferably used for the observation of continuously variable counting rates. The requirements in respect to scope of measurement and scale range vary greatly. It is often desired, for example, that monitors cover a range of five decades. The three most common types are described: counting rate meters (1) with linear scale, (2) with compressed, approximately logarithmic scale, (3) with strictly logarithmic scale. After a general review, a counting rate meter developed by Telefunken is described. The Telefunken counting rate meter incorporates a linear section followed by a logarithmic section. (tr-auth)

27344 PRECISION AND REPRODUCIBILITY OF COUNT RATES (MEASUREMENTS WITH GIEGER-MUELLER COUNTING TUBES). H. Erbe. Telefunken Ztg., 35: No. 135, 6p. (1962). (In German)

The accuracy with which measurements can be made with the aid of series-produced Geiger-Müller counter tubes and counters under normal laboratory conditions is investigated. For these measurements the Radiation Monitoring Equipment MS Str 610 and the Standard Equipment MS Str, produced by Telefunken, were employed. The time curve of the radiation emitted by a Cs^{137} sample was registered. At the beginning and after termination of the series of measurements the characteristic of the counter tube was ascertained. It was seen that the data of the counter tube remain unchanged over the measuring time during which about 2 to 3×10^8 pulses were released. To ascertain the accuracy of the counter rate over time, 60 measurements were made during one month, 10^6 pulses being counted in each case, so that a standard deviation of 10^{-3} may be expected. From the slope of the average straight line the half life of the sample can be determined at $\tau = 25.4$ years. The known value is 30 years, the relative mean deviation of the measured points from the straight line is $\sigma = 1.16‰$, instead of the expected value of 1‰. Towards the end of this reliability test, the radiation level at the counter tube was increased by a second sample several times for about 10 mins in such a manner that the counting losses amounted to ~40%. The values following this overloading were summarized and compared with the others. After the overloading the counting rates dropped by ~1‰ on an average over 4.5 hours. For the purpose of checking, the counting rate was measured in 10 and 1 min intervals before and after a sudden load. No effect was found which exceeded the statistic deviation of 0.5 or 1.5% respectively. In order to determine the duration of the warming-up period of the equipment, the drift of the counting rate after switching on was measured on four days by taking measurements of the counting rate in short time steps. It results that the measuring error after 4 min warming-up time is surely smaller than the standard deviation of 3‰: the initial error of the first value originates predominantly from the heating-up process of the tubes. (auth)

27345 SOLID STATE DOSIMETRY. Charles G. Amato, S. J. Maisky, and R. Roswit (Brookhaven National Lab., Upton, N. Y.). Trans. N. Y. Acad. Sci., 23: 357-74(Feb. 1961). (BNL-4794)

Design features are described for a small radiation dosimeter comprised of a glass host matrix and a silver fluorescent activator. The absorption of ionizing radiation causes the ionization of $Ag_3(PO_3)$. A photochemical reaction then reduces ionic silver to metallic silver. Metallic silver emits an orange-yellow fluorescence that is directly proportional to the radiation exposure and can be converted into an electrical signal through the use of an optical bypass filter and a photomultiplier. Range selection is obtained by placing a voltage divider in the input circuit. The use of Au, Cd, or Li alloy shields to increase the sensitivity of the dosimeter are discussed. Calibration, reading, and use as needle implant dosimeters are described. (C.H.)

27346 NEW RADIATION METHODS OF ACTIVE CONTROL OF DIMENSIONS. V. V. Kondashevskii and A. N. Chertovskikh. p.518-41 of "Vzaimozamenyayemost' i Tekhn. Izmereniya v Mashinostr." Moscow, Mashgiz, 1960.

A description is given of a slot method of component dimension control. A very narrow beam of x or γ rays is formed by means of two diaphragms. The beam from the radiation source is directed nearly tangentially to the component surface onto the radiation detector, the intensity of radiation reaching the detector being uniquely dependent on the position of the component inside the measuring beam. With proper calibration the instrument may be used for controlling the dimensions of components on lathes and grinders. The source and radiation detector, together with the diaphragms which form a narrow beam, are tightly coupled together. The proposed method is useful for controlling component parts of any diameter with a weak source which must be adequate, however, to be able to pass through the layer of cooling liquid, but safe for the operator. The measurement procedure is given for x rays, bremsstrahlung, and soft γ radiations. The results of the experiments show that by now, the slot method of active control, using x rays and GM counters, gives a measurement error ~1,2 – 6 microns, which is quite adequate for machining shafts on lathes and circular grinders. Recommendations as to the choice of radioactive sources are given. (Referativnyy Zhurnal, No. 5, 1961)

27347 APPLICATION OF THE PHENOMENON OF GAMMA-RAY ABSORPTION TO AUTOMATIC CONTROL OF THE COMPOSITION OF COMPOSITE MEDIA. L. A. Pivovarov. p.175-82 of "V sb. Avtomat. Upravleniye." Moscow, Academy of Sciences, USSR, 1960.

Basic processes of the interaction between a radioactive radiation and substance are briefly outlined. It is shown that for gamma-ray absorption by a composite medium there exists an equality which has on its R.H.S. the mass absorption coefficient for the whole medium, and on its L.H.S., the sum of the products of the individual component mass absorption coefficient and individual component concentration in the mixture. For a number of gamma-ray sources a system of linear algebraic equations of the first degree can be formed. If the absorption coefficients for the individual components are known, the problem of determining their concentration is reduced to automatic solving by means of a computer of a system of equations, the R.H.S. of which (mixture absorption coefficients) is being determined continuously during measurement. Recommendations are made regarding the choice of suitable radiation sources. To determine concentrations of n components the number of sources required is (n-1), since the sum of the concentration is equal to unity. To secure a high-accuracy solution for the system of equations it is necessary that the component absorption coefficients differ as much as possible from each other. The strongest dependence of the absorption coefficient on the mixture composition is ob-

served in the case when the photo-effect is the predominant process of the interaction. In this connection it is advisable to choose a soft gamma-ray source with energies not exceeding 0.3 – 0.5 Mev. Retarded radiation can also be used. A description of the experimental apparatus is given together with results of measurements. (Referativnyy Zhurnal, No. 4, 1961.)

27348 ADVANCED INSTRUMENTATION FOR A GAMMA RAY COUNTING SYSTEM TO MEASURE THE RADIOACTIVITY OF HUMANS. H. D. LeVine (New York Operations Office, AEC). In Proceedings of 5th International Instruments and Measurements Conference, Sept. 13-16, 1961. New York, Academic Press, 1961. (HASL-100)

The first types of human counters consisted of instrumentation and shielding techniques which provided remarkable advances in the art. With the basic knowledge and the operational characteristics established, a second generation of equipment became feasible. The low background facility at the Health and Safety Laboratory of the United States Atomic Energy Commission has been designed to expand the utility of these counters. The circuits, the instrument designs, and the detector arrangement have been carefully examined. Information is presented on the circuits used, the characteristics of the radiation detectors, the feasibility of various arrays of photomultiplier tubes, especially with reference to securing a minimal background count with optimized energy resolution and counting efficiency. An instrument which is an accessory to the design of the shielding of a system is a bulk counter with mercury shielding designed to evaluate the radioactive content of the characteristics of paints, flooring, cloth, metals, plastics and some of the commercially manufactured items used in the counter. A primary problem has been the need for special foundations, building construction and the mechanical problems associated with the enormous weight of the original units in building. The low background facility at the Health and Safety Laboratory has been designed for placement on a normal floor with no added building reinforcement. (auth)

27349 PROCEEDINGS OF INSTRUMENT SOCIETY OF AMERICA 1960 SYMPOSIUM ON SAFETY FOR ELECTRICAL INSTRUMENTATION IN HAZARDOUS AREAS, WILMINGTON, DELAWARE, MAY 2, 3, 1960. VOLUME I. Pittsburgh, Instrument Society of America, 1960. 124p.

Nine papers presented at the Instrument Society of America 1960 Symposium on Safety for Electrical Instrumentation in Hazardous Areas are given. Topics covered include: history of ISA committee on hazardous area instrumentation, organization and operation of the electrical code committee, electrical ignition of combustible atmospheres, heat transfer and computational considerations in the design of instrument cases for operation in hazardous atmospheres, intrinsic safety, considerations in instrument case purging, explosion-proof enclosures, reducing the hazard from electrical components and assemblies, and insurable risks. (M.C.G.)

27350 PROCEEDINGS OF THE SYMPOSIUM ON NUCLEAR INSTRUMENTS, HARWELL, SEPTEMBER 1961. J. B. Birks, ed. New York, Academic Press Inc., 1962. 532p.

Photoelectric devices, scintillation chambers and counters, semiconductor detectors, spark chambers, etc., are discussed. Methods for recording and analyzing complex nuclear data are explained. Thirty-three papers are included; separate abstracts have been prepared for 31. Two papers were previously abstracted in NSA. (L.N.N.)

27351 SOME PROBLEMS IN PHOTOELECTRONIC IMAGE INTENSIFIERS FOR USE IN HIGH-ENERGY PHYSICS. J. D. McGee (Imperial Coll., London). p.1-23 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Photoelectronic image intensifiers possess a high inherent efficiency in detecting light. An electronic image stream can be gated at high speeds, and an image store can be provided having a wide choice of time duration. Techniques in these fields are reviewed. (L.N.N.)

27352 FILAMENT SCINTILLATION CHAMBER EXPERIMENTS IN WEAK INTERACTIONS. G. T. Reynolds, D. B. Scarl, R. A. Swanson, J. R. Waters, and R. A. Zdanis (Princeton Univ., N. J.). p.24-34 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Filament scintillation chambers are described, and their uses in weak-interaction experiments are discussed. Meson (μ^-) capture by C^{12} is explained, and data from π^+ and μ^+ decay are given in tabular form. A schematic of the filament chamber designed to detect the decay $\pi^+ \rightarrow \pi^0 + e^+ + \nu$ is presented. (L.N.N.)

27353 TIME RESOLUTION IN SCINTILLATION COUNTERS. E. Gatti and V. Svelto (Centro Informazioni Studi Esperienze, Milan). p.35-53 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Statistical properties of available signals from radiation detectors are assessed. Theoretical and experimental results on properties of the photoelectric emission from the photocathode lit by a given flash from a particular phosphor and on the single-electron response of the electron multiplier, which allow design of the most convenient instrumentation for extracting time information from scintillation detectors, are considered. Systematic errors in timing devices, calibration using delay lines, and methods for improving stability are discussed. Single-channel time analyzers (coincidences) are compared with multi-channel time analyzers (time sorters). (L.N.N.)

27354 EXPERIMENTAL DETERMINATION OF THE INFLUENCE OF NON-PROPORTIONAL RESPONSE OF NaI(Tl) CRYSTALS UPON THE RESOLUTION OF SCINTILLATION DETECTORS. P. Thieberger, E. C. O. Bonacalza, and H. Ryde (Nobel Inst. of Physics, Stockholm). p.54-61 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Single primary electrons were generated inside the scintillator by allowing γ radiation to be scattered by a single Compton process in the crystal and by detecting the scattered photon in a second detector. Fluctuations in scintillation efficiency due to statistical distribution of Compton electrons and photoelectrons in the first crystal are eliminated; contributions from δ electrons remain. (L.N.N.)

27355 USE OF A LIQUID HELIUM SCINTILLATOR AS A NEUTRON POLARIMETER. J. E. Simmons and R. B. Perkins (Los Alamos Scientific Lab., N. Mex.). p.62-6 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Design and performance of a practical liquid helium counter for measuring neutron polarization from the $T(d,n)He^4$ reaction are described. Schematics of the cryostat construction and the experimental geometry are given. Pulse height distributions for helium recoil pulses gated by coincidence scattering events are presented in graphical form. (L.N.N.)

27356 A HIGH RESOLUTION PARTICLE IDENTIFICATION SYSTEM. D. A. Bromley, M. W. Sachs, and C. E. Anderson (Yale Univ., New Haven, Conn.). p.67-74 of

"Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

A charged-particle identification system based on simultaneous measurement of the specific energy loss and residual energy, similar to that of F. A. Aschenbrenner (Phys. Rev. 98: 657(1955)), is described. The system is used to study heavy-ion induced reactions. Advantages from the plethora of charged reaction products are derived. (L.N.N.)

27357 SILICON AND GALLIUM ARSENIDE CONDUCTION COUNTERS. O. Simpson (Services Electronics Research Lab., Baldock, Herts, Eng.). p.75-83 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Effects of imperfections in real semiconductors on their resolving power for particles when the distance between the electrodes exceeds a few millimeters are described. Properties of bulk conduction counters having ohmic contacts were used in analyzing the general bulk properties of counters. Experimental results using silicon and gallium arsenide bulk conduction counters are discussed. Silicon counters must be operated at liquid-air temperatures; gallium arsenide can be operated at room temperature. Lack of purity and uniformity in gallium arsenide does not allow it to be competitive with silicon in energy resolution. (L.N.N.)

27358 SEMICONDUCTOR NEUTRON COUNTERS. G. Dearnaley and A. T. G. Ferguson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.84-92 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Silicon and germanium semiconductor detectors of the surface barrier and diffused junction types are adapted for neutron detection using the reactions $Li^6(n,\alpha)T$, $He^3(n,p)T$, $B^{10}(n,\alpha)Li^7$, and $H(n,n)H$. Flux and spectrum measurements and radiation damage are discussed, and the He^3 and proton-recoil counters are described. (L.N.N.)

27359 THIN SILICON SURFACE BARRIER COUNTERS. P. T. Andrews (Univ. of Liverpool). p.93-7 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Solid-state detectors offer the possibility of making a thin counter for measuring the ionizing power of a particle before it enters another detector in which the total energy of the particle is measured. This allows distinction between particles of like energy but differing mass and simplifies interpretation of particle energy spectra; all ions produced in a thin silicon slice when a particle passes through it must be collected. Thin silicon detectors of N-type material using gold surface-barrier electrodes are described; back contacts are made by evaporating layers of aluminum, beryllium, or magnesium. (L.N.N.)

27360 TEMPERATURE EFFECTS IN SILICON P-N JUNCTION DETECTORS. E. Baldinger, W. Czaja, and J. Gutmann (Univ. of Basel). p.98-103 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

The origin of recombination losses is examined; temperature dependence is formulated semiquantitatively from space-charge distributions. (L.N.N.)

27361 STUDIES ON THE USE OF SPARK CHAMBERS IN MAGNETIC FIELDS. G. R. Burleson, A. Roberts, and T. A. Romanowski (Argonne National Lab., Ill.). p.104-21 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Optimum conditions for operating a set of large spark chambers in a magnetic field were examined for multiple-particle-event track observations. Gas mixtures and operating conditions giving high efficiencies for single and multiple tracks and a sufficiently short clearing time with a moderate clearing voltage to avoid excessive alternate displacements in a magnetic field were obtained. Cosmic showers having ten or more particles were recorded; spark-chamber usefulness was limited only by the inherent limitations of the chamber resolution. (L.N.N.)

27362 EXPERIENCE WITH SPARK CHAMBERS IN HIGH ENERGY PHYSICS. P. G. Murphy (National Inst. for Research in Nuclear Science, Harwell, Berks, Eng.). p.122-5 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Experiments using spark detectors were performed; schematics of equipment are given. Proton polarization π^--p interactions at 500 to 940 Mev; K^+ elastic scattering by H at 1.0, 1.2, and 2.0 Bev/c; and proton polarization in the decays $\Sigma^+ \rightarrow p + \pi^0$ and $\Lambda \rightarrow p + \pi^-$ were measured. (L.N.N.)

27363 RECENT WORK ON SPARK CHAMBER TECHNIQUES. W. Galbraith, P. H. Sharp, and A. C. Sherwood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.126-35 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Uses of spark detectors as visual indicators of beam position and as triggered electric pulse counters in which the chambers play a role similar to that of scintillation detectors having gated photomultipliers are discussed. (L.N.N.)

27364 THE USE OF CLOSED CIRCUIT TELEVISION IN THE SELECTION OF SPARK CHAMBER EVENTS. J. G. Rutherglen and J. M. Paterson (Univ. of Glasgow). p.136-9 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

To save film and scanning time by recording only the photographs of interest, a closed-circuit television system is employed. The camera was set up to view a four-section spark chamber triggered by cosmic radiation, and the monitor screen was photographed on a continuously-moving film. The process is limited to cases in which an accelerator produces a short beam lasting 1 or 2 msec at a submultiple of the 50 cps main frequency. Generalizations of applications and possible improvements are discussed. (L.N.N.)

27365 USE OF A SPARK CHAMBER IN A SEARCH FOR NEUTRINO-LESS CONVERSION OF MUONS INTO ELECTRONS. M. Conversi (Univ. of Rome). p.140-1 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

A search for the reaction $\mu^- + N \rightarrow N + e$ was made. Apparatus design and performance are described. (L.N.N.)

27366 TRENDS IN NUCLEAR DATA PROCESSING. M. Surdin (Centre d'Etudes Nucléaires, Saclay, France). p.144-6 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Conditions that electronic equipment should satisfy in experiments, in which human intervention is reduced to setting up and generally supervising by a visual overall control are described. Versatility, reliability, and monitoring are considered. (L.N.N.)

27367 MULTIDIMENSIONAL ANALYSIS OF NUCLEAR DATA. Y. Amram, H. Guillon, and J. Thenard (Centre d'Etudes Nucléaires, Saclay, France). p.147-56 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

A bidimensional analyzer, 2×3, intended for (n,γ) studies and having 2^{10} channels (1024 channels of time-of-flight and 64 of amplitude) is described. Difficulties encountered in (n,γ) experiments are discussed. (L.N.N.)

27368 IMPROVEMENTS IN RESONANCE ANALYSIS METHODS, AND DATA HANDLING ON AN IBM 7090 COMPUTER AS APPLIED TO NEUTRON TRANSMISSION EXPERIMENTS. G. Bianchi, C. Corge, V.-D. Huynh, J. Julien, J. Morgenstern, and F. Netter (Centre d'Etudes Nucléaires, Saclay, France). p.157-62 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

The total-cross-section behavior near resonance energies is described by the one-level Breit-Wigner formula, and an expression for the transmission is derived. Calculations are extended to cases in which the resolution effect and phase shifts cannot be neglected. Data are processed by automatic methods. Limits on the number of samples that can be considered are removed. (L.N.N.)

27369 A SYSTEM FOR DETECTING AND PROCESSING ENERGY SPECTRA FOR SEVERAL TYPES OF CHARGED PARTICLES SIMULTANEOUSLY. C. D. Goodman and J. B. Ball (Oak Ridge National Lab., Tenn.). p.163-7 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Measurement of charged-particle energy spectra requires the use of an energy-sensitive particle detector and a means of distinguishing particle types. A two-coördinate counter system for simultaneously measuring the energy spectra from (p,p'), (p,d), (p,t), and (p,α) reactions at 22 Mev is described. The two coördinates are the pulse heights from a pulsing counter and a stopping counter; these measure ΔE and E. (L.N.N.)

27370 HIGH SPEED INTERMEDIATE STORAGE SYSTEMS. K. Kandiah (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.168-77 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

A method for achieving a dead time of about 5μ sec in a system used with pulsed accelerators is considered; the system is broken down into two parts. One consists of a temporary store having a short dead time for dealing with the data as it is received during the accelerator pulse; the other consists of a permanent store into which the temporary store feeds the information during the dead time. The permanent store may be a conventional multichannel analyzer or a two-stage system using a magnetic tape recorder followed by an analyzer. (L.N.N.)

27371 APPLICATIONS OF MAGNETIC ANALOGUE RECORDERS. P. E. Cavanagh, C. F. Coleman, and B. W. Ridley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.178-81 of "Proceedings of the Symposium on Nuclear Instruments." New York Academic Press Inc., 1962.

The recording system (Cavanagh and Boyce, Rev. Sci. Instr. 27: 1028) uses intensity modulation of the tape, which is subjected to h-f biasing. A schematic of the replay system is given, and mass and energy spectral data from proton reactions with Co^{59} at 30 Mev are presented. Comparison with digital systems is made. (L.N.N.)

27372 MULTITRACK RECORDING ON MAGNETIC TAPE. J. C. Barton (Northern Polytechnic, London). p.182-8 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Magnetic recording systems having narrower tracks than the usual 10μ × 10μ × 750μ were investigated in an effort to increase information density. Methods developed for making multitrack recording heads and possible methods for reproducing the recorded information are discussed, and requirements for further development are given. (L.N.N.)

27373 A TRANSISTOR MAGNETIC CORE MULTIDIMENSIONAL KICKSORTER. T. K. Alexander, L. B. Robinson, and R. A. McNaught (Atomic Energy of Canada Ltd., Chalk River). p.189-96 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Analysis of nuclear events described by two or more parameters requires an analyzer having many channels. If the analyzer is designed allowing flexibility in its use, the storage channels are used more efficiently. Specific experiments can be performed using fewer data-accumulating channels. A 900-channel magnetic-core analyzer was designed using a digital magnetic-tape system. (L.N.N.)

27374 A 20,000-CHANNEL PULSE-HEIGHT ANALYSER WITH TWO-CO-ORDINATE ADDRESS. C. D. Goodman and G. D. O'Kelley (Oak Ridge National Lab., Tenn.) and D. A. Bromley. p.197-200 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Analyzers having 20000-channel memories and 10^6 counts per channel storage capacity are described. Two analog-to-digital converters and two address scalers arranged to provide a basic 100 × 200 channel-sorting and storage array that can be rearranged to 50 × 400 or 20 × 1000 by a selector switch are provided. Ease of operation for non-routine exploratory experiments is emphasized. Data can be transferred from the analyzer to a computer by transferring the tape to a computer tape drive. The computer can write new tapes containing processed data that can be examined on the analyzer display. The analyzer can be used to record correlated data for which circuitry can be built to generate the address codes. (L.N.N.)

27375 A COMMENT ON ADDRESS SYSTEMS FOR TWO-DIMENSIONAL PULSE ANALYSIS. G. W. Hutchinson (Univ. of Southampton, Eng.). p.201 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

An addressing system using the actual deflection of the cathode-ray tube spot to provide the address is proposed. Positions of the curves to be distinguished are found on the screen by photography or observation, and black "contour" lines are drawn between them. Motion of the spot from its quiescent position to any given address region involves passage over a characteristic number of the lines, independent of the spot's path. If the spot remains bright during the deflection period and the screen is viewed using a photomultiplier, a waveform consisting of a train of pulses having a number characterizing the address is produced. This number can be scaled and used to direct the recording of the event in the appropriate channel or group of channels. (L.N.N.)

27376 A DETECTION SYSTEM FOR HEAVY IONS. J. A. McIntyre, F. C. Jobes, and T. L. Watts (Yale Univ., New Haven, Conn.). p.202-9 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

A system for heavy-ion detection was developed. Energy resolutions of the order of 1 Mev, or better, are obtained, and efficiencies are comparable to those of counter detectors. The system eliminates complicated fast electronics systems, operates as well with pulsed or continuous-duty accelerators, and has an extremely high discrimination against the large flux of stable isotopes present in heavy-ion experiments. (L.N.N.)

27377 THE CURRENT ROUTING AMPLIFIER: A NOVEL CIRCUIT ELEMENT. A. F. Arbel (Atomic Energy Commission, Tel Aviv, Israel). p.210-19 of "Proceedings

of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Versatility of current-operated equipment is increased by adding an element that may be used as a window amplifier, discriminator, and/or current gate; it is essentially an operational amplifier having an output current that balances the sum of all signals applied to its virtual ground input. The maximum speed of the input pulses is limited by the diode speed. Recovery after discrimination is complete. Hysteresis is practically nonexistent, making the discriminator useful as a zero crossing detector for timing bipolar pulses. Current-routing amplifiers may be used as error current detectors in digital current meters; sensitivity is limited only by the d-c amplifier input impedance. (L.N.N.)

27378 THE U.C.L.A. 50 MeV SECTOR-FOCUSED CYCLOTRON. D. J. Clark, K. R. MacKenzie, E. L. Petersen, J. R. Richardson, and B. T. Wright (Univ. of California, Los Angeles). p.220-9 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

A description of the design and properties is given; schematic diagrams are included. Performance data are presented in graphical form. (L.N.N.)

27379 A FAST NEUTRON TIME-OF-FLIGHT SYSTEM FOR USE WITH CYCLOTRONS. H. W. Fulbright (Univ. of Rochester, New York). p.230-1 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

A system used in a 27-in. variable-energy cyclotron is described. The overall time resolution obtained is 1.5 to 3 nanosec. Operation depends upon the narrow width in time for the naturally-bunched individual beam pulses. (L.N.N.)

27380 A CLOSED CIRCUIT TELEVISION SYSTEM PROVIDING AUTOMATIC TRACK-CENTERING AND TRACK-FOLLOWING IN CLOUD CHAMBER PHOTOGRAPHS. B. R. Pullan (Univ. of Leeds, Eng.). p.232-5 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Semi-automatic measuring projectors aid in analyzing cloud and bubble chamber photographs consisting of two or more stereoscopic views. Using a measuring projector, the two-dimensional coordinates of tracks on films are measured with respect to a fiducial system. Co-ordinate transformations are made to determine the tracks' three-dimensional co-ordinates in space. Measurements consist of observing how far the film or fiducial mark must be moved from a fixed origin to set the fiducial mark on to a feature on the film. A relatively simple and inexpensive system for automatically setting on to and driving along tracks on cloud chamber photographs is incorporated in a measuring projector. The measurement process in the projector is done automatically, using moiré fringe digitizers. (L.N.N.)

27381 INVESTIGATIONS OF THE TRANSFER REACTIONS IN THE BOMBARDMENT OF NUCLEI WITH HEAVY IONS BY MEANS OF DELAYED NEUTRON DETECTION. G. N. Florov, L. Pomorski, J. Tys, and V. V. Volkov (Joint Inst. for Nuclear Research, Dubna, USSR). p.242-6 of "Proceedings of the Symposium on Nuclear Instruments." New York, Academic Press Inc., 1962.

Thick targets of Cu, Al, and Ta were exposed to N^{14}, N^{15}, O^{16}, Ne^{20}, and Ne^{22} ions; N^{17} nuclei generation was observed in all cases. Internal beams from a heavy-ion cyclotron were used. The decay curve for the neutron activity from Ta exposure to Ne^{20} ions is plotted; similar curves were obtained for other targets and ions. Effective cross sections for the reactions were measured; results are plotted. A block scheme of the apparatus is presented; operation of the equipment is described. (L.N.N.)

27382 A Li^6-LOADED GLASS SCINTILLATOR FOR NEUTRON DETECTION. G. G. Slaughter, F. W. K. Firk (Oak Ridge National Lab., Tenn.), and R. J. Ginther. p.425-9 of "Proceedings of the Symposium on Neutron Time-of-flight Methods, Organized by the European-American Nuclear Data Committee (Saclay, France, July 24-27, 1962), Session IV."

A cerium-activated, Li^6-loaded glass scintillator of relatively high Li^6 content is developed and used for detecting neutrons with energies from the thermal region to 80 kev. The glass has a decay time of 100 ns, and a scintillation efficiency 12 to 15% that of NaI(Tl). The Li^6 $(n,\alpha)T$ reaction in the glass produces a pulse height distribution that peaks at an equivalent electron energy of about 1.8 Mev and exhibits a resolution of 18 to 25%. A time resolution of about 4 ns is obtained using a "fast-slow" coincidence system. The efficiency of a glass cylinder 1.5 in. long is 20% for 1-kev neutrons incident parallel to the axis of the cylinder. (auth)

27383 IMPROVEMENTS RELATING TO ELECTRICAL PULSE GENERATING CIRCUITS. Cedric Harold Flurscheim and William Warden Holburn (to Associated Electrical Industries Ltd.). British Patent 900,102. July 4, 1962.

An apparatus for generating electric current pulses was developed. It consists of an annular conductor or coil movable through an annular gap in a magnetic flux path to generate current pulses together with mechanical actuators distributed around the conductor or coil and a means for actuating them synchronously to drive the conductor or coil through the flux and thereby generate a pulse. The improvement relates mainly to fluid operated prime movers, but the distribution of thrust into multiple units makes it possible to effect the necessary acceleration of the coil by using the stored energy in a battery of loaded springs. (M.C.G.)

27384 HIGH SENSITIVITY IONIZATION CHAMBER. Leslie Emil Johnson. British Patent 900,428. July 4, 1962.

A sensitive ionization chamber is designed for use at high temperatures. The chamber comprises a sealed cylindrical outer container with inner electrode means defining an inner compartment filled with an ionizable gas. The space between the outer container and the inner assembly is filled with an inert gas to protect the inner assembly against oxidation and to act as a pressure-compensating means. (D.L.C.)

27385 IMPROVEMENTS IN AND RELATING TO MEASURING SYSTEMS. (to Industrial Nucleonics Corp.). British Patent 900,646. July 11, 1962.

A radiometric thickness measuring device for continuous measurement of a moving material, e.g., cigarette rod, is designed so that the flutter effect due to the movement of the material is greatly reduced. The device comprises an elongated structure having an aperture along its longitudinal axis perpendicular to the first aperture for radiation absorbance measurements. The detector side of the second aperture is partly blocked so that radiation bypassing the moving material is prevented from reaching the detector. Thus, the signal variation due to material movement may be reduced from 5 to 0.5%. (D.L.C.)

27386 IONIZATION CHAMBER. Norman Trevor Clarke (to United Kingdom Atomic Energy Authority). British Patent 900,913. July 11, 1962.

A pressurized ionization chamber is designed which has an almost flat gamma energy response down to about 60 kev. The chamber is filled with 18 to 22 atm of an argon-air mixture in the proportions 55 to 65 vol % argon and 45 to 35 vol % air. The sensitivity of the chamber for 7.5 mr/hr gamma radiation is 8.1×10^{-11} amp. (D.L.C.)

27387 SENSITIVE LOW VOLTAGE PROPORTIONAL COUNTER. (to Socony Mobil Oil Co., Inc.). British Patent 900,979. July 11, 1962.

A proportional counter using pressurized He^3 is designed for detecting thermal and epithermal neutrons. In the counter, a high electrostatic field is established across the pressurized He^3 and current pulses due to $He^3(n,p)$ reactions are measured; for detecting epithermal neutrons only, a Cd or B shield may be used. The advantages of the counter are that high efficiencies are obtained at low voltages and gamma radiation is not detected. The counter is particularly useful to neutron well logging with or without a neutron source. (D.L.C.)

27388 IMPROVEMENTS IN OR RELATING TO LAMINATIONS AND LAMINATED STRUCTURES SUITABLE FOR USE IN ELECTRICAL APPARATUS. Leslie Reginald Blake (to United Kingdom Atomic Energy Authority). British Patent 901,459. July 18, 1962.

Laminations and laminated structures were developed for use in electrical apparatus to provide a low reluctance magnetic flux path in one direction and a high impedance current path in a transverse direction. The lamination consists of a tube of magnetic material having an insulating inner surface, flattened longitudinally and end sealed. The laminations were developed for use in an electromagnetic induction pump for liquid metals. (M.C.G.)

27389 RADIATION DETECTION APPARATUS. (to Controls for Radiation, Inc.). British Patent 902,215. Aug. 1, 1962.

A radiation sensing and warning device was developed. It consists of a combination of a sensing element arranged to provide a signal output of a magnitude depending on the radiation impinging on the element, signal amplifying means for amplifying the signal provided by the sensing element, and a warning means. The sensing element includes a phosphor element sensitive to the selected types of radiation and a semiconductor material disposed in optically coupled relationship with the phosphor element such that the resistance characteristic of the sensing element varies as a function of the magnitude of the radiation over the range of 0 to 5000 r/hr. (M.C.G.)

27390 IMPROVEMENTS IN OR RELATING TO MASS SPECTROMETERS. John Bishop (to United Kingdom Atomic Energy Authority). British Patent 902,647. Aug. 9, 1962.

A mass spectrometer is designed for use with gaseous samples such as UF_6. The spectrometer comprises an ion source compartment housing an ion source and a pipe for introducing a sample to the ion source, the ion source having a mount for inserting and withdrawing from the compartment unhindered by the pipe in a direction transverse to the direction of firing of the ionized beam. (D.L.C.)

27391 IMPROVEMENTS IN OR RELATING TO RADIATION DETECTING DEVICES. (to Philips Electrical Industries Ltd.). British Patent 902,684. Aug. 9, 1962.

A radiation detection device is designed for detecting overheated bearings of railway carriages by means of their infrared emission. The device uses optical modulators and filters for deriving two separated beams from a radiation superimposed on an undesired or stray radiation and for alternately projecting these beams on a detector surface; the output voltage of the detector is adjusted to a constant value when only the stray radiation is present. (D.L.C.)

27392 AN APPLIANCE FOR MEASURING THE DENSITY OF LIQUIDS. (to Commissariat à l'Énergie Atomique). British Patent 903,265. Aug. 15, 1962.

An accurate magnetic densitometer is designed which enables very rapid measurements to be made. The densitometer comprises a thermostatically controlled enclosure for containing the liquid to be investigated, a magnetic float arranged to alter the balance of a differential transformer outside the enclosure, means for feeding the current from the transformer to a solenoid to restore balance to the float, and means for measuring the current as an indication of the liquid density. The densitometer may be used for measuring the H_2O content in D_2O to the nearest 40 ppm between 0 and several 10,000 ppm. (D.L.C.)

27393 DEVICE FOR MEASURING A ROTATION MOVEMENT, ESPECIALLY IN PLACES SUBMITTED TO AN INTENSE NEUTRON FLUX. (to Siemens & Halske A. G.). French Patent 1,230,084. Sept. 13, 1960.

In water-cooled reactors it is sometimes necessary to measure the coolant flow in individual channels. In order to effect this measurement at extreme weak circulations a vaned rotor of the so-called Woltman Type is mounted with its rotor axis in the direction of the fluid flow. The speed of this rotor is proportional to the fluid flow. The rotor is made of a material resistant to the influence of the neutron flux (e.g., aluminum, zirconium, magnesium, permenorm, or steel V4a), and changes periodically the inductance of a coil placed in the proximity of the rotor and well, by the passage of the vanes or of teeth mounted on the rotor. This periodic variation of the inductance controls an appropriate measuring circuit. (NPO)

27394 DEVICE FOR THE MEASUREMENT OF THE CHANGES IN DIAMETER OF HOLLOW PRESSURIZED CYLINDRICAL BODIES. (to Sulzer Frères). French Patent 1,232,835. Oct. 12, 1960.

In order to control the changes in diameter of cylindrical high-pressure ducts that are not accessible from the outside (e.g., such as are placed in caverns), the diameter is checked from inside during the operation of the installation. The movements of opposite wall regions are transmitted to a spring having an annular shape, and the strain on the spring caused by the movements is measured by strain gauges mounted on the spring. The strain gauges are connected via cables with a measuring instrument positioned outside the pressurized ducts. (NPO)

27395 SWITCHING CIRCUITRY. (to United Kingdom Atomic Energy Authority). French Patent 1,240,365. July 25, 1960.

In order to switch a great number of thermocouples successively to a measuring instrument, so that this switching is performed with a speed of, e.g., thousands of commutations per second, an electronic switching device is provided with a beam-switching tube such as the "Dekatron" tube. In this tube an electric discharge arises between a common anode and one of a series of cathodes, each of which is connected via resistors to ground. This resistor forms a voltage divider with a collector connected via a diode with one of the terminals of the thermo-couple, the other terminal being connected, together with the corresponding terminals of the other thermo-couples, with an amplifier. If a given cathode conducts a current to the ground potential, a voltage drop arises so that the collector gets a potential sufficient to make the diode conducting. The voltage generated by the corresponding thermo-couple then controls the amplifier, while the other thermo-couples do not influence the

amplifier. The current beam is switched from cathode to cathode by applying a switching signal to two control electrodes of the tube. (NPO)

27396 FISSION CHAMBER ASSEMBLY. Leo R. Boyd and Richard G. Bock (to General Electric Co.). U. S. Patent 3,043,954. July 10, 1962.

A fission chamber assembly for the continuous determination of neutron flux in a reactor core is described which is of simplified design and is rugged and reliable. (D.L.C.)

27397 DISCRIMINATING RADIATION DETECTOR. Stephen S. Friedland, James W. Mayer, and John S. Wiggins (to Hughes Aircraft Co.). U. S. Patent 3,043,955. July 10, 1962.

A semiconductor detector is designed for discriminating charged particles, particularly monoenergetic alpha particles. The detector has a p-n junction crystal close to the incident surface. The energy of the incident particles is determined by measuring the current of the pulses from the depletion region. (D.L.C.)

27398 FORMATION LIQUID LOGGING. Stanley B. Jones and Robert J. S. Brown (to California Research Corp.). U. S. Patent 3,044,010. July 10, 1962.

A nuclear magnetic logging method is outlined for determining the liquid content of earth formations traversed by a well bore. The method comprises inducing a magnetic field in the bore, interrupting the field to permit free precession of the responsive protons, detecting the total signal amplitude of the precession, and measuring separately the contributions to the amplitude by protons in the drilling fluid and in the formation liquids. (D.L.C.)

27399 DARK-FIELD ILLUMINATION SYSTEM. Duane U. Norgren (to U. S. Atomic Energy Commission). U. S. Patent 3,045,528. July 24, 1962.

A means was developed for viewing objects against a dark background from a viewing point close to the light which illuminates the objects and under conditions where the back scattering of light by the objects is minimal. A broad light retro-directing member on the opposite side of the objects from the light returns direct light back towards the source while directing other light away from the viewing point. The viewing point is offset from the light and thus receives only light which is forwardly scattered by an object while returning towards the source. The object is seen, at its true location, against a dark background. The invention is particularly adapted for illuminating and viewing nuclear particle tracks in a liquid hydrogen bubble chamber through a single chamber window. (AEC)

27400 MULTIPLE THICKNESS TIMES DENSITY GAMMA GAGE. N. H. Cherry (to U. S. Atomic Energy Commission). U. S. Patent 3,046,402. July 24, 1962.

A device was developed for measuring simultaneously the thicknesses of two dissimilar materials superimposed on each other, such as coating of one material on another. The apparatus utilizes a double gamma radiation source producing radiation in two narrow band energy levels. The different materials attenuate the two bands of energy unequally with the result that a composite signal is received which can be analyzed to separate out the components due to the differing materials and indicate the thickness or densities of the two layers. (AEC)

27401 FOCUSING MASS SPECTROMETER. Giichi Iwata. U. S. Patent 3,047,717. July 31, 1962.

A mass spectrometer with high transmission was developed which utilizes a combination of special electric and magnetic fields. This combination of fields produces a perfect focusing effect for ions of like mass-to-charge ratio regardless of their initial velocity and position. A means to produce a uniform magnetic field and a means to produce a hyperboloidal electric field including an electrode are provided. The electrode consists of a pair of parallel insulating discs, facing each other, perpendicular to the direction of the magnetic field. A plurality of concentric conducting rings insulated from each other are mounted to the discs. A pair of circular rings are connected to the outmost ring of each of the insulating discs, and a net of conducting wires forming a hyperboloidal surface connect the two rings. An ion source and an ion detector-collector are located in the hyperboloidal field. (M.C.G.)

27402 HELIUM 3 SCINTILLATION NEUTRON DETECTOR. James A. Rickard (to Jersey Production Research Co.). U. S. Patent 3,047,720. July 31, 1962.

A scintillation detector was developed for obtaining neutron energy spectra by distinguishing between ionization pulses produced by elastic scattering and by the (n,p) reaction. The detector consists of spaced-apart photomultiplier tubes and a plurality of spaced-apart scintillating means (phosphors) arranged between the tubes. The space between the phosphors contains He^3. The phosphors are arranged such that light generated by adjacent scintillating means enters different photomultiplier tubes, and the photomultiplier tubes are connected for coincidence counting. The He^3 gas in reactions with neutrons produces tritons and protons which are counted by the coincidence circuit. (M.C.G.)

27403 DIRECTIONAL GAMMA RAY DETECTION UNIT. Theodore R. Folsom and John D. Isaacs (to U. S. Navy). U. S. Patent 3,047,721. July 31, 1962.

A radiation detector system was developed to indicate directionally the presence of radioactive materials in water with a measure of the intensity. The object of this system is to provide vessels cruising in the vicinity of nuclear detonations with efficient means of detecting harmful areas, and to detect fallout and measure its intensity. The detector system consists of two gamma sensing elements, an indicating means for registering the presence of radiation, an electric cable connecting these two, comparatively massive shielding so that the sensors are not responsive to radiations emanating from the vehicle, and a radiation permeable cover for the sensing elements and shielding. (M.C.G.)

27404 GEIGER-MÜLLER COUNTING TUBE. Johannes Hermsen, Pieter Johannes Kraaijeveld, and Nicolaas Warmoltz (to North American Philips Co. Inc.). U. S. Patent 3,047,760. July 31, 1962.

A Geiger-Mueller counting tube was developed. The envelope has closely-spaced wall portions forming a first smaller counting discharge space and widening extensions of the wall portions and integral therewith forming a second larger radiation-receiving space communicating with the first space via an opening located at the junction of the closely-spaced wall portions and widening extensions. The ionized gas filling in the envelope includes at least 0.001% of a halogen-type quench. The cathode and anode electrodes were adapted and arranged to sustain a discharge within only the first smaller space and are located in positions permitting the passage of particles generated substantially anywhere in the second space by incident radiation to the first space between the electrodes to initiate discharges therein. (M.C.G.)

27405 RADIATION DETECTOR TUBES. Dennis H. Howling (to McGraw-Edison Co.). U. S. Patent 3,047,761. July 31, 1962.

Radiation detector and/or counter tubes were developed with electrode structures which are refined to such a high degree as to enable the tubes to be manufactured within extremely close tolerances and to have a markedly better stability and life than the prior forms of such tubes. The tube consists of a pair of spaced electrodes, a gas-tight radiation-permeable envelope enclosing the electrodes, and a means of supporting the electrodes to provide a single integrated working region. Fabricating techniques and processing steps which are carried out to refine the electrode structure are described. (M.C.G.)

27406 COUNTER TUBE. Talbot A. Chubb. U. S. Patent 3,048,730. Aug. 7, 1962.

A photon counter of the Geiger type is designed which has greater stability, longer life, improved plateau characteristics, and selective response to radiation between 1425 and 1500 A. The photon counter has a sapphire window and is filled with 2 mm xylene, 10 mm hydrogen, and 400 mm neon. (D.L.C.)

27407 FLUID REMNANT MAGNETIZATION TESTER. Robert J. S. Brown (to California Research Corp.). U. S. Patent 3,048,773. Aug. 7, 1962.

A method and apparatus are described for determining the magnetic properties of drilling mud by means of nuclear magnetic relaxation measurements. Thus, the contribution of the drilling mud to nuclear magnetic logging signals can be determined. (D.L.C.)

27408 DIFFERENTIAL ČERENKOV COUNTER. Frank C. Genovese, Jr. (to U. S. Navy). U. S. Patent 3,049,619. Aug. 14, 1962.

A Čerenkov counter is designed for velocity-analyzing a high-energy particle beam of large cross section. The counter has a relatively large input aperture and can detect charged particles moving parallel to, but off, the axis of symmetry of the dielectric radiator. The radiator is a fluid at its critical point where it has a continuously variable refraction index. (D.L.C.)

27409 SCINTILLATION DETECTOR COOLING SYSTEM. Wayland D. George, Stanley B. Jones, and Herbert P. Yule (to California Research Corp.). U. S. Patent 3,049,620. Aug. 14, 1962.

A well logging apparatus for irradiating earth formations with neutrons and recording the gamma rays emitted therefrom is designed which has a scintillation decay time of less than 3×10^{-4} sec and hence may be used with more intense neutron sources. The scintillation crystal is an unactivated NaI crystal maintained at liquid N_2 temperature. The apparatus with the cooling system is described in detail. (D.L.C.)

27410 ENERGY MODULATION. David L. Spooner (to Industrial Nucleonics Corp.). U. S. Patent 3,049,621. Aug. 14, 1962.

A method is given for modulating the energy of radiation in order to test the frequency response of a radiation instrument for measuring the physical properties of a continuous material. The method is described with particular reference to testing of a cigarette rod weight analyzer. In the method, the cigarette rod in the gage pass tube is replaced with a helix rod modulator having helical protuberances on its surface and which is rotated to effect sinusoidal variations in the beta radiation reaching the detector. The method is also described with reference to testing of a fluid servomechanism. (D.L.C.)

27411 METHOD AND DEVICE FOR THE MEASUREMENT OF MAGNETIC FIELDS BY MAGNETIC RESONANCE. Anatole Abragam, Jean Combrisson, and Ionel Solomon (to Commissariat à l'Énergie Atomique). U. S. Patent 3,049,661. Aug. 14, 1962.

A method for precisely determining weak magnetic fields is given which may be used to measure local variations in earth's magnetic field in geophysical prospecting. The method comprises locating in the magnetic field to be measured a solution of a paramagnetic free radical of stationary hyperfine structure and having an electronic resonance frequency band, applying an alternating magnetic field to saturate the electronic resonance band, and measuring the frequency of the electromagnetic radiation absorbed by the atomic nuclei of the solvent. The solution preferredly is an aqueous solution of a nitrosodisulfonate, and a device for carrying out the method is described in U. S. Patent 3,049,662. (D.L.C.)

27412 METHOD AND DEVICE FOR THE MEASUREMENT OF MAGNETIC FIELDS BY MAGNETIC RESONANCE. Anatole Abragam, Jean Combrisson, and Ionel Solomon (to Commissariat à l'Énergie Atomique). U. S. Patent 3,049,662. Aug. 14, 1962.

A device for precisely determining local variations in earth's magnetic field is designed which may be used in geophysical prospecting. The device comprises an aqueous solution of nitrosodisulfonate ions, a high-frequency circuit for saturating the electronic resonance band of the solution, a low-frequency circuit, means for tuning the low-frequency circuit on the nuclear resonant frequency, and means for measuring the energy generated in the low-frequency circuit in the magnetic field. The principles involved are discussed in U. S. Patent 3,049,661. (D.L.C.)

Materials Testing

27413 NONDESTRUCTIVE QUALITY CONTROL: SOME SPECIAL METHODS OF IRRADIATION TESTING. T. Van der Klis. Bedrijf en Tech., 16: 507-9(June 10, 1961).

Various methods, using open radioactive sources are discussed. In one method, oil is used containing Pd^{109} which is adsorbed by Mg compounds with which the object to be tested is covered after it has been enveloped in a photographic film. Another method consists of cooking the material in the radioactive oil and then scanning it with a suitable detector. A third method, applied especially to porous materials, uses pressure to promote the penetration of the radioactive oil into the cracks and fissures. The filtered particle technique is also used for detection of cracks or cavities in porous materials, such as ceramics, cement, graphite pressed powdered metals, and sintered carbides. In this method, radioactive liquids are used along with fluid fluorescent substances. Finally, a method is mentioned in which radioactive powder is made to adhere to the surface of the investigated objects by means of an electrostatic charge. This method is used for quality control of china, glass, email, and electric insulation material. (OID)

27414 DESIGN OF PERFORATED PLATES. W. J. O'Donnell and B. F. Langer (Westinghouse Electric Corp., Pittsburgh). J. Eng. Ind., 84: 307-20(Aug. 1962).

A method for calculating stresses and deflections in perforated plates with a triangular penetration pattern is discussed. The method is based partly on theory and partly on experiment. Average ligament stresses were obtained from purely theoretical considerations but effective elastic constants and peak stresses were derived from strain meas-

urements and photoelastic tests. Acceptable limits for pressure stresses and thermal stresses in heat-exchanger tube sheets are also proposed. (auth)

27415 GENERAL THEORY FOR THE DETECTION OF DEFECTS IN FUEL ELEMENT CLADDINGS IN HETEROGENEOUS REACTORS. F. W. Krueger (VEB EPkA, Berlin). Kernenergie, 5: 462-71(June 1962). (In German)

Fission products are released into the coolants of reactors by faults in the fuel element cladding. The detection of faults is generally done by detection of these fission products. In order to localize the defect, a part of the coolant stream which flows past the given number of elements was drawn off and led to a detector. The localization was made difficult if the coolant in the surface is mixed outside of the active zone. Therefore, soon after the origin of a defect fission products arrived at all detectors. Moreover, often the fuel element claddings are surface contaminated with fuel material, or the cladding material contains traces of fissionable materials. During reactor operation fission products also originate from these impurities, contaminate the coolant, and make difficult the detection of cladding defects. By consideration of these effects, a general representation of the specific activity of the fission products in the coolant at the site of the detectors is given. The signal/noise ratio for a defect monitor was derived and discussed for various defect and operating states. The results were clarified using the Shippingport Reactor as an example. They permit conclusions to be drawn on the selection of suitable detection methods. (tr-auth)

27416 TESTING OF THIN-WALLED TUBES FOR FUEL ELEMENT CANNING UNDER EXTERNAL AND INTERNAL PRESSURE. Paul Bettzieche. Nukleonik, 4: 184-9(June 1962). (In German)

Studies under exterior and interior pressure at different temperatures were carried out on thin-walled tubes of X 10 CrNiNb 18 10 with about 14.5 mm exterior diameter and 0.2, 0.3, and 0.4 mm wall thickness. It was established how in such tubes filled with pellets the bulge pressure changes with increasing temperature and with the magnitude of the free space between the pellets or between the pellets and plug. The exterior pressure at which a longitudinal wrinkling first occurs in the tube was established in dependence on the diameter clearance pellet: tube, and the bursting pressure without pellets was determined. The data obtained were supplemented with the help of a comparative calculation and plotted in diagram form. The diagrams permit a calculation of what pressures under given conditions of temperature and pellet size will cause bulge and wrinkling formation in the tube. (tr-auth)

GEOLOGY, MINERALOGY, AND METEOROLOGY

27417 (AERE-R-4018) THE CAESIUM-137 CONTENT OF SOIL IN THE UNITED KINGDOM–1960. L. Salmon (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1962. 14p.

The amount of Cs^{137} deposited on the soil in the U.K. was determined from measurements of soil samples by gamma-ray spectrometry. The relation between Cs^{137} in soil and rainfall was examined, good correlation being found with results from other workers. An estimate of the external dose rate from Cs^{137} was also made. At the end of 1960, the amount of Cs^{137} deposited in any locality was approximately proportional to mean annual rainfall (1 mC/km^2/inch) and the external dose rate in a region of high rainfall (123 inches per year) was 1.1 μr/hr. An estimate of the amount of dry deposition is uncertain but it is unlikely to have exceeded 8 mC/km^2 anywhere as compared with the observed average deposit of 44 mC/km^2. (auth)

27418 (NP-11961) PHENOMENA IN THE UPPER ATMOSPHERE REVIEW OF SOVIET LITERATURE. AID Work Assignment No. 3, Report 26. (Library of Congress. Aerospace Information Div., Washington, D. C.). June 30, 1962. 27p. (AID-Report-62-105)

Summaries are presented of 21 Soviet publications received during June 1962 covering selected aspects of astrophysics and geophysics. The materials deal with solar radiation and the ionosphere, Van Allen belts and cosmic rays, atmospheric electricity, satellite and missile data, and meteorology of the upper atmosphere. (C.H.)

27419 (TEI-809) GEOLOGY OF THE WILLISTON BASIN, NORTH DAKOTA, MONTANA, AND SOUTH DAKOTA, WITH REFERENCE TO SUBSURFACE DISPOSAL OF RADIOACTIVE WASTES. Charles A. Sandberg (Geological Survey, Washington, D. C.). June 1962. 156p.

The southern Williston basin, which underlies about 110,000 square miles in North Dakota, South Dakota, and eastern Montana, is part of a large structural and sedimentary basin. The sedimentary sequence that fills the basin has a maximum thickness of about 16,700 feet and rests on Precambrian metamorphic rocks at depths of 500 to 13,900 feet below sea level. It contains rocks of every geologic system from Cambrian to Quaternary. Rocks of the Williston basin are gently folded and regional dips are 1° or less from the margins to the basin center. The most important mineral resource of the area is oil, which is produced predominantly from the Paleozoic carbonate sequence and largely on three of the major anticlinal folds, and lignite, which is present near the surface in Paleocene rocks. The subsurface disposal of radioactive wastes at some places in the Williston basis appears to be geographically and geologically feasible. Many sites, at which large quantities of wastes might be injected with minimal danger of contamination of fresh-water aquifers with oil-producing strata, are available. The strata and types of reservoirs that deserve primary consideration for waste disposal are the Winnipeg Formation of Middle Ordovician age as a deep salaquifer, the Permian to Jurassic salt beds as moderately deep units in which solution cavities might be created for storage, the thick Upper Cretaceous shale beds as shallow hydraulically fractured shale reservoirs, and the Newcastle Sandstone of Early Cretaceous age as a shallow shale-enclosed sandstone reservoir. (auth)

27420 (TID-16015) LETTER PROGRESS REPORT FOR APRIL 1962 [ON HIGH ALTITUDE SAMPLING]. (General Mills, Inc., Minneapolis). May 15, 1962. Contract AT(11-1)-401. 15p.

Progress is reported in the design and testing of equipment for high-altitude air sampling. The operational characteristics of an air ejector were tested over a complete range of back pressures and primary pressures. Data are tabulated. Modifications were made in an altitude sensor for use on balloons at high altitudes. A balloon flight was made to 110,000 ft with two direct-flow units and an electrostatic precipitator. A sketch is included of the flight train and components used. Total payload on the balloon was 506 lbs. A second balloon flight was made to obtain a vertical profile of radioactive debris with direct-flow units at 70,000 and 80,000 ft. This was accomplished by using a gondola equipped with two direct-flow units and ballast to float the system at the lower of the two altitudes. After sampling was completed at the lower step, the ballast was dropped, and the system ascended. Total payload on the balloon was 865.5 lb. (C.H.)

27421 (TID-16348) CORRELATION AND CHRONOLOGY OF ORE DEPOSITS AND VOLCANIC ROCKS. Annual Progress Report No. 4. Paul E. Damon (Arizona. Univ., Tucson. Geochronology Labs.). July 10, 1962. Contract AT(11-1)-689. 114p.

Results are reported from investigations of the helium method of age determinations for minerals, the use of the helium method and other methods such as the K-Ar and common Pb isotope techniques to determine the age of ore deposition in areas in the Southwestern United States, application of geochemical-petrographic-geologic correlation techniques to the problem of volcanic stratigraphy in the Southwest, and the relationship of ore deposition to volcanism. Appended are results of an investigation of color centers in fluorite with application to geologic time, results from a study of uranium and thorium diffusion in magnetite, results of age measurements on Older Pre-Cambrian ignimbrite from central Arizona, results of investigations of the helium dating method by stable isotope dilution technique, and the results of field, microscopic, and geochemical studies of the Cat Mountain rhyolite in the southern portion of the Tucson Mountains, Pima County, Arizona. (C.H.)

27422 (TID-16370) GEOLOGIC ASPECTS OF THORIUM RECOVERY FROM COMMON ROCKS. Final Report. June 1, 1961 through May 31, 1962. (Rice Univ., Houston, Tex.). For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26]; Subcontract 1491. 44p.

Field laboratory determinations of the thorium content of the Conway granite were made. The results indicate that the accessible Conway granite contains 56 ± 6 ppm thorium as an average, with few samples having less than 40 or more than 100 ppm. Much of this thorium is contained in accessory mineral grains, which are commonly enclosed within biotite and more rarely in feldspar. The thorium is primary and is uniformly distributed through the fresh rock. The main mass of the Conway granite underlies an area of at least 300 square miles, and the present surface of the Conway has over 2000 feet of relief. Based on the assumption that the Conway granite at depth is not markedly different from the rock exposed, calculations show a thorium metal content of 3+ × 10^6 metric tons per 100 feet of depth

in the main mass alone. Experiments indicate that over 2/3 of the contained thorium and associated uranium can be recovered by acid leaching followed by solvent extraction. In terms of nuclear energy uses, the Conway granite represents a major low-grade thorium resource. (auth)

27423 (UCRL-13040) REVIEW OF FRACTURING THEORIES. David C. Card, Jr. (Colorado School of Mines Research Foundation, Inc., Golden). Apr. 16, 1962. For Univ. of California Lawrence Radiation Lab., Livermore. Contract [W-7405-eng-48]. 72p.

A review is presented of work concerning fracture which attains a close approximation to physical events from the periphery of a plastically deformed region outward into the medium. It is maintained that the most significant mechanism in the formation of a crater-like failure in rock is brittle fracture. Of particular concern is the brittle failure of rock as it is subjected to explosive loading from the interior. It is shown that much is known concerning fracturing and relatively less is known about the association of fracture with explosive loading, especially in the case of elastic half-spaces in which the source is contained within the space. (J.R.D.)

27424 RADIOACTIVITY FALL-OUT IN 1960 IN BUCHAREST. A. Iorgulescu and M. Oncescu. Acad. rép. populaire Roumaine, Rev. phys., 6: 335-40(1961). (In English)

The radioactivity of atmospheric samples (rain and dust) was measured in Bucharest in 1960. The sampling and measurement methods are given, and the possible sources of error are discussed. The results are shown graphically. The accumulation of activity in the soil was also calculated. (J.S.R.)

27425 RADIOACTIVE FALL-OUT IN THE RUMANIAN PEOPLE'S REPUBLIC FROM NOVEMBER 1958 TO DECEMBER 1959. D. Blănaru, T. Gabe, A. Iorgulescu, R. Literat, V. Mageru, and M. Oncescu (Inst. for Atomic Physics, Bucharest and Iasi Branch of the Academy of the R.P.R.). Acad. rép. populaire Roumaine, Rev. phys., 6: 341-6(1961). (In English)

The results of radioactivity measurements on rain and snow residues and dust at Bucharest and Iasi from Nov. 1958 to Dec. 1959 are reported. The sampling and measurement methods are described. (J.S.R.)

27426 THE ENRICHMENT OF URANIUM IN SOME BROWN COALS IN HUNGARY. A. Szalay (Univ. of Debrecen, Hungary). Acta Geol. Acad. Sci. Hung., 2: 299-311 (1954). (In English)

Geochemical enrichment of uranium is ascertained in some brown coal strata in Hungary. These strata are situated near to the detritus zone of the two existing granitic mountains of Hungary. The uranium content of these coal strata is about the same (about 0.01%) as the U content of bioliths (oil shales, carbonate rocks etc.) used to be. It seems highly probable that the same unknown general geochemical law is responsible for all such enrichments in bioliths. The granitic rocks are the primary sources of uranium, the U migrated into the sea or moor water during the age of chemical decomposition of the rocks. Uranium became adsorbed by the decomposing organic substance of the sediments. Laboratory experiments revealed that decomposing plant debris, peat, lignite, and brown coal have a very high adsorption power and capacity for uranium, which is in fact sufficiently high to explain geochemical enrichment. Subsequent experiments revealed and control experiments verified that the humic acid colloid particles are responsible for the adsorption, which is a cation exchange process. The adsorption equilibrium constant of humic acid substance is much higher for uranium than for cations of lower valence and lower atomic weight. It seems, that the hitherto unknown law of geochemical enrichment of uranium in bioliths is herewith explained. This law may be formulated in the following manner: the geochemical enrichment of uranium in carbonate rocks (bioliths) is caused by the adsorption of dissolved uranium by the humic acid content of the sediments. The adsorption is a cation exchange process. (auth)

27427 A CONTRIBUTION TO THE STUDY OF THE MINERAL URANOSPHERITE. Augusto Baptista, Neysa Rocha Baptista, and Oswaldo Erichsen de Oliveira (Comissao Nacional de Energia Nuclear, Rio de Janeiro). Anais acad. brasil. cienc., 34: 45-9(1962). (In English)

Two attempts were made to synthesize a chemical compound corresponding to the mineral uranospherite ($Bi_2O_3 \cdot 2\ UO_3 \cdot 3\ H_2O$). In both attempts, acid solutions of uranyl and bismuth nitrates were neutralized with sodium hydroxide solutions; an orange precipitate was obtained whose formula, $2\ UO_3 \cdot Bi_2O_3 \cdot 7.5\ H_2O$, differs from that of the uranospherite only in the water content. X-ray powder data were obtained for the synthetic compound and compared with data for the uranospherite. The results suggest that the uranospherite is a hydrated basic bismuth uranate, tetragonal, with $a_0 = 7.404$ A and $c_0 = 6.939$ A. (D.L.C.)

27428 AGE OF A MID-ATLANTIC RIDGE BASALT BOULDER. Donald R. Carr and J. Laurence Kulp (Columbia Univ., New York). Bull. Geol. Soc. Am., 64: 253-4(Feb. 1953).

A helium age measurement was made on one of the fine-grained gray basalt boulders taken at Atlantic Expedition Station 7, Lat. 3001, Long. 4501, depth 4279 meters, in 1947. The helium content of a 10.7349 g sample was 0.27×10^{-6} cm^3/g. The radium content found was $0.031 \pm 0.002 \times 10^{-12}$ g/g. Assuming radioactive equilibrium and a Th/U ratio of 3.5, the calculated values for uranium and thorium were 0.085×10^{-6} and 0.298×10^{-6} g/g, respectively. Using these values measured ages of 14.4 and 16.4 million years were obtained for 2 runs. It was concluded that the most probable absolute age is 30 ± 15 million years. (M.C.G.)

27429 U–Pb AGE OF THE CHATTANOOGA SHALE. J. C. Cobb and J. L. Kulp (Columbia Univ., New York). Bull. Geol. Soc. Am., 71: 223-4(Feb. 1960).

An attempt was made to date the upper black unit of the Gassaway member of the Chattanooga shale which carries the maximum U/Pb ratio. Three samples were analyzed by isotopic dilution techniques. The U^{238}-Pb^{206} ages on all 3 samples agreed within their experimental errors. The average of the two samples with reasonably small errors gave an apparent age of 350 ± 10 million years. (M.C.G.)

27430 C.E.A. MINING RESEARCH IN AFRICA. B. Blangy. Bull. inform. sci. et tech. (Paris), No. 59 19-26(Mar. 1962). (In French)

The results obtained in the various African territories studied by the C.E.A. prospection groups are reviewed. The African territories surveyed include Sahara, Mauritania, Republic of Mali, Senegal Republic, Dahomey Republic, Volta Republic, State of Cameroun, Gabon Republic, Central African Republic, and Nigerian Republic. After several years of methodical research, work was concentrated on the regions of Franceville (Gabon) and Agadez (Nigeria). In this last region important mineral-bearing seams have been under detailed study since 1959. (auth)

27431 GEOLOGICAL CHARACTERISTICS OF THREE NEW FRENCH URANIUM DEPOSITS. A. Lenoble. Bull.

inform. sci. et tech. (Paris), No. 59, 27-42(Mar. 1962). (In French)

Easily detectable uranium deposits are becoming increasingly rare, and in order to discover them or define their extent, it is now necessary to use more and more delicate geological research methods. This becomes clear from the detailed description given of three new French deposits: Chardon, Jalerys, and Herault deposits. The Chardon deposit (Loire-Atlantic) is small, but rich. Its complete structure was worked out from slight surface indications. In the Jalerys deposit (Saone-et-Loire) the absence of outcrops held up investigations for many years. The Herault deposits, in general, are characterized by good surface indications, but they required the marked improvement of stratigraphic and tectonic methods for depth prospection. (auth)

27432 CHARACTERISTICS OF NEW MINING SITES. L. Vuchot and P. Bruley. Bull. inform. sci. et tech. (Paris), No. 59, 43-57(Mar. 1962). (In French)

The equipment of the C.E.A. mining research and exploitation was adapted to the characteristics of the French deposits, and it provides the possibility of passing almost without a break from one stage of work to the next. Heavy exploitation equipment is now installed on the principal sites, and this is described in detail. This is followed by a description of the mining units of La Crouzille, the Vendee, and the Forez. (auth)

27433 BERYLLIUM ORES. ACTUAL CHARACTERISTICS AND CONDITIONS FOR INCREASING THE SUPPLY. A. Gangloff. Bull. inform. sci. et tech. (Paris, No. 59, 64-70(Mar. 1962). (In French)

Up until the last few years, beryl, the principal ore of Be, was produced on a small scale from pegmatite deposits. The development of new applications for Be raises the need to discover new reserves of this metal. This can be achieved by concentrating on the search for low-concentration deposits, but with a more regular and greater tonnage than the pegmatite deposits now exploited. To find these deposits, prospecting methods must be adapted, particularly the use of special detectors. The commercial exploitation of these deposits requires the development of new concentration methods and the adaptation and improvement of present chemical treatment processes. (auth)

27434 RADIOACTIVE DEPOSIT. A. van der Linde (Univ. of Utrecht). Chem. Weekblad, 57: 556-60(1961).

Radioactive isotopes were identified in deposits from fall-out from nuclear weapon tests by using β absorption curves and γ spectra. Beta absorption curves are given for $Ru^{106} + Cs^{137}$ for low energies (0–20 mg/cm^2 absorber thickness) and medium energies (0–500 mg/cm^2 absorber thickness) and of the alkaline earth group (0–360 mg/cm^2 absorber thickness). Gamma spectrum of a preparation with Na^{22}, Co^{60}, Cs^{137}, and Rh^{106} is also given. Explosion data from Russian experiments in the Novaya Semlya area, October 1958, were identified in November 1958. In August 1959, Ce^{144}, Pm^{147}, Nb^{95}, Rh^{106}, Ru^{103}, Cs^{137}, and Zr^{95} were identified. In soil and rain water measured in August and November, U^{238}, Sr^{89}, K^{40}, and the other isotopes were found. Atmospheric activity during November 1958 shows a steady increase. (P.C.H.)

27435 THE NATURAL TRITIUM ECONOMY OF THE EARTH AND THE QUESTION OF ITS VARIATION WITH TIME. F. Begemann (Max-Planck-Institut für Chemie, Mainz). Chimia (Switz), 16: 1-10(1961). (In German)

The production of tritium in the atmosphere by cosmic-ray reactions and its distribution to the various hydrogen-containing reservoirs in the earth are discussed. The distribution of tritium on earth is described. The tritium production and destruction rates are compared. Possible causes of high tritium production and its variation with time are outlined. (M.C.G.)

27436 DETERMINATION OF SOME OLIGOELEMENTS IN GEOLOGICAL MATERIALS BY NEUTRON IRRADIATION AND PAPER CHROMATOGRAPHY. René Coulomb (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Compt. rend., 254: 4328-9(June 18, 1962). (In French)

Two methods for the analysis of oligoelements (Mn, Cu, Sc, Co, Ga, W, Ta, Th, and U) in complex geological materials are proposed. The methods are based on an association of the efficiency of paper chromatographic separations with the high sensitivity of neutron activation. (tr-auth)

27437 GEOCHEMICAL STUDIES OF MINERAL DEPOSITS IN THE LISBON VALLEY AREA, SAN JUAN COUNTY, UTAH. Vance Clifford Kennedy (Univ. of Colorado, Boulder). Dissertation Abstr., 22: 3154-5(Mar. 1962).

A geochemical study is made of uranium-vanadium, copper, and manganese deposits in the Lisbon Valley area from 1954 to 1957. The composition of the various types of ore is determined and the information is combined with mineralogic and geologic data to evaluate various hypotheses of ore genesis. Uranium-vanadium deposits occur as generally tabular bodies in or near sandstones of the Permian Cutler formation, the Triassic Chinle formation, and the Salt Wash member of the Jurassic Morrison formation. The Cutler ores contain uranium, vanadium, copper, barium, and lesser—but still anomalous—concentrations of cerium, dysprosium, erbium, germanium, holmium, lanthanum, lead, niobium, neodymium, silver, and yttrium. Copper concentrations are highest in Cutler ore near the Lisbon Valley fault. Large deposits of basal Chinle sandstones lie along the southwest flank of the Lisbon Valley anticline. These deposits consist mainly of uranium and vanadium but contain anomalous concentrations of arsenic, barium, beryllium, cadmium, cobalt, copper, iron, lead, molybdenum, nickel, some rare earths, selenium, strontium, thallium, zinc, and zirconium. The vanadium:uranium ratio is highest in the southeastern Chinle ores and decreases northwestward. This ratio also decreases down dip, possibly because of selective leaching of uranium. Arsenic, molybdenum, and yttrium are most concentrated in the southeastern deposits; cadmium and copper in the middle area, and strontium and beryllium in the northwestern deposits. The ore-associated elements in Chinle deposits show only a poor correlation with uranium, except for lead. The uranium:lead ratio is relatively consistent and averages approximately 33:1. Assuming that very little common or old radiogenic lead is present, the uranium:lead ratio indicates an apparent age of the ores of about 225 million years. Corrections for alteration of the ore might give an age in the range indicated by some isotopic data, that is 180 to 190 million years. Comparison of barren and mineralized Salt Wash sandstones indicates that arsenic, barium, beryllium, calcium, cobalt, copper, lead, manganese, molybdenum, strontium, uranium, vanadium, yttrium, and zinc are enriched in one or more mineralized samples. The Rattlesnake deposit, which is cut by the Lisbon Valley fault, contains more selenium than other Salt Wash ores analyzed. In the southeastern part of the Lisbon Valley area copper minerals are more common in Salt Wash deposits within about a mile of the Lisbon Valley fault than they are elsewhere. Otherwise no evidence of chemical zoning is noted. Copper minerals occur mainly in veins and bedded deposits near the Lisbon Valley fault zone, but are present in minor

amounts in some uranium-vanadium deposits several miles from the fault. Copper-bearing veins also cut altered diorite porphyry in the La Sal Mountains. The copper deposits vary somewhat in composition, but most contain arsenic, barium, molybdenum, selenium, and silver. Manganese oxides are present as vein fillings and disseminated deposits along the Lisbon Valley fault. Compared to barren sandstones the manganese ores are enriched in arsenic, barium, cobalt, copper, molybdenum, selenium, silver, strontium, vanadium, and zinc. The genesis of the uranium-vanadium ores is believed to be different from that of the copper and manganese ores. The latter are thought to have been deposited mainly from solutions circulating along and spreading outward from fault zones. Most copper ores are not older than the Cretaceous, and the Chinle uranium-vanadium deposits seem to be of Triassic or Early Jurassic age. Because connate waters squeezed from red beds during compaction must have passed through the sites of present uranium-vanadium deposits and because it seems possible that these fluids could have carried the ore elements in solution, connate waters are believed to have constituted the ore fluid.

27438 GEOCHEMISTRY OF THE FRENCHY INCLINE URANIUM DEPOSIT, SAN MIGUEL COUNTY, COLORADO. Alfred Thomas Miesch (Northwestern Univ., Evanston, Ill.). Dissertation Abstr., 22: 3156(Mar. 1962).

The Frenchy Incline uranium deposit is in the Salt Wash member of the Morrison formation on the central part of the Colorado Plateau, and consists of sandstone and mudstone impregnated with uranium and vanadium minerals in addition to other constituents. The compositions of the deposit and its host rocks are determined from semiquantitative spectrographic analyses of 219 drill-core samples. Comparison of the compositions of the mineralized and unmineralized rocks shows that in the formation of the deposit the host rocks are enriched in vanadium, iron, uranium, strontium (?), lead, zinc, copper, chromium (?), nickel, cobalt, molybdenum, and silver, in decreasing order of abundance. In general, this is the same suite of elements found to be enriched in other uranium deposits in the Salt Wash member of the Morrison formation on the Colorado Plateau. Quantitative considerations show that most of the enriched elements in the Frenchy Incline deposit could be derived from altered sandstone adjacent to the deposit without changing its composition by any detectable amount. However, uranium and probably vanadium are derived from sources external to the altered part of the sandstone lens in which the deposit occurs; an unknown amount of lead in the deposit originates from the radioactive decay of uranium within the deposit. If the elements are transported to the deposit by flowing ore solutions, the required minimum concentration of each element in the solution depends on the volume of the solution that passes through the deposit. Assuming that the hydraulic gradient that causes solution flow results from differences in hydrostatic head caused only by the dip of the aquifer, the maximum volume of the solution passing through the deposit per unit time, for a given structural gradient, may be estimated from Darcy's law. The required minimum concentration of each element in the ore solution, then, becomes a function of the duration of mineralization and the structural gradient. Probably not all elements that are enriched in the deposit are transferred to the site of mineralization by flowing solutions. Thermodynamic considerations suggest that concentration gradients of iron in solution are established in the host sandstone during an early period of relatively stagnant ground-water conditions. Iron and other elements may be transferred by solute diffusion processes occurring in response to the concentration gradients. The regional variations of elements among other uranium deposits in the Salt Wash member point to the sources of these elements in the deposits. It is interpreted that iron, molybdenum, cobalt, nickel, selenium, arsenic, and part of the zinc in the deposits are derived chiefly from tuffaceous materials in or associated with the host sandstone. Some copper, silver, and lead in the deposits may also be derived from the host sandstone. Additional copper, silver, lead, and part of the zinc are derived from sources external to the Salt Wash member by way of fractures in the salt anticline region of western Colorado and eastern Utah. Vanadium in the deposits may be derived from heavy minerals in the host sandstone, but not from the altered part of the lens in which the deposit occurs. Uranium in the Frenchy Incline deposit, and in other deposits in the Salt Wash member, may be derived from magmatic sources that produce the laccoliths of the La Sal Mountains, from extensive tuffaceous accumulations in the Morrison formation, or from other sources. It is possible that uranium precipitates from solution on the reduction of uranyl ions by earlier accumulations of pyrite. An hypothesis of origin for the Frenchy Incline uranium deposit is given that involves at least two stages of mineralization. The hypothesis accounts for the regional distributions of elements in the uranium deposits of the Salt Wash member over the entire Colorado Plateau, and interprets the deposits as resulting from the interaction of dynamic and chemical processes. The dynamic processes control hydrologic conditions within the Salt Wash member, and the chemical processes act in response to changes in these conditions.

27439 MEASUREMENT OF RADIOACTIVE CONTAMINATION OF SURFACE WATER. PART I. ORIGIN OF RADIOACTIVITY OF WATER. Ch. A. Bizollon. L'Eau, 48: 272-4(Sept. 1961).

General descriptions are given of sources and levels of natural radioactivity; principal sources of artificial contamination; disappearance of radioactivity as effected by physico-chemical adsorption and absorption by living organisms; and the more toxic radioactive elements likely to be contributed by effluent wastes. (Public Health Eng. Abstr., 42: No. 8, Aug. 1962)

27440 SULFUR ISOTOPE ABUNDANCES IN ROCKS OF THE SUDBURY DISTRICT AND THEIR GEOLOGICAL SIGNIFICANCE. H. G. Thode, H. B. Dunford, and M. Shima (McMaster Univ., Hamilton, Ont.). Econ. Geol., 57: 565-78(June-July 1962).

A study was made of the distribution of the sulfur isotopes in the Precambrian rocks of the Sudbury district. The sulfur isotope ratios obtained for the nickel irruptive including samples of the Cu–Ni ores, associated norite, and micropegmatite are consistent with the conventional picture of a single sheet-like intrusive of magma that underwent some gravity controlled process of differentiation. The sulfur isotope ratios obtained from Cu–Ni ore and associated norite samples from the Stillwater igneous complex in Montana, parallel those obtained for the corresponding Sudbury samples. The Cu–Zn–Pb deposits found in faults between igneous and sedimentary rocks in the center of the Sudbury basin, support the view that these ores are hydrothermal deposits derived from the micropegmatite possibility during the last stages in the differentiation of the irruptive. The sedimentary rocks south of the Sudbury basin are found to be very uniform in sulfur isotope content and to have a sulfur isotope ratio almost identical with that of meteorites ($\delta S^{34} = 0$). The sediments inside the basin, on the other hand, vary markedly in sulfur

isotope content and have isotope ratios which extend beyond the range usual for igneous rocks. These results are in agreement with other evidence that the ancient sediments inside and outside the basin, were laid down under quite different conditions. The results suggest that the sediments inside the basin, in particular the graphite rich slates, were formed in an environment in which extensive localized biological activity took place. The low C^{13} content of these slates, $\delta C^{13} = -36.9$ per mil with respect to standard limestone, also suggests life processes in proterozoic times. (auth)

27441 GEOCHEMISTRY OF THE SILICEOUS BLACK SHALES AT NAGARJUNASAGAR DAMSITE, INDIA. P. S. N. Murty, U. Aswathanarayana, and C. Mahadevan (Andhra Univ., Waltair, India). Econ. Geol., 57: 614-16 (June-July 1962).

Studies were made on the Precambrian black shales exposed at 400- to 500-ft depths at the Nagarjunasagar dam site to investigate the possibility of their being uraniferous. Analysis of samples show ranges of 0.06 to 0.52 ppm U, 0.07 to 0.70% organic C, 0.14 to 1.30% S, 0.43 to 1.49% ferrous ion, 1.19 to 5.84% ferric ion, and 63.8 to 81.2% silica. The low U content is probably due to absence of reducing conditions. (D.L.C.)

27442 ON THE DATING OF Pb-MINERALS. W. Schuetze (J. W. Goethe Universitilt, Frankfurt am Main). Geochim. et Cosmochim. Acta, 26: 617-47(June 1962). (In German)

From the isochronal slopes of primary Pb and parallel lines of secondary Pb, and similarly from the constants for the central relation $n_g = U^{238}/Pb^{204}$, the age of the elements of the planetary system is found to be $T_E = 5.0 \pm 0.1$ Ga. This is identical with the age of nuclear genesis of heavy elements found from the condensation age $T_k = 4.59$ Ga of a meteorite and a Reynolds time for a time interval between the origin of I^{129} and the condensation of a meteorite. The results show that the earth is condensed from a meteor cloud and that a closed system remains until discharge of primary Pb. It is also concluded that in the time interval until discharge, a good mixing must have occurred. Thus, in this time interval events are no longer knowable as condensation, melting, and nuclear and surface binding in lead isotopes. Although $n_g = 9.84$ is a good average value for meteorites, Pb and U are almost always strongly enriched in the crust, while Th is more strongly enriched. Rules are given for age determination of Pb minerals: (1) A single measurement cannot be dated. (2) Primary Pb can be dated from the isochronal method with $T_0 = 5.0$, $x_0 = 7.88$, $y_0 = 6.97$, and $z_0 = 28.05$. (3) Secondary Pb can be dated from the isochronal method when the primary isochrone pertaining to it is known. In a system of secondary Pb with a known isochrone trend, a hypothetical isochrone can be inferred, whereby the relation that n_g for primary Pb is equal to that for secondary Pb can be used. (4) Anomalous Pb can be dated when two isochronal systems, dy/dx and (dy/dx)', are known, or when the primary Pb is known. The condition $n_g \simeq n_g'$ is not fulfilled in this case, and anomalous Pb is therefore differentiated from the usual secondary Pb. (tr-auth)

27443 IRIDIUM IN STONE METEORITES BY NEUTRON ACTIVATION ANALYSIS. P. R. Rushbrook and W. D. Ehmann (Univ. of Kentucky, Lexington). Geochim. et Cosmochim. Acta, 26: 649-57(June 1962). (In English)

Chemical and radiometric procedures for the determination of submicrogram amounts of iridium in silicate materials by use of neutron activation were developed. These procedures were applied to the analyses of six chondrite meteorites, one achondrite meteorite, and standard rock G-1. A cosmic abundance value for iridium based on the chondrite analyses of this work was calculated to be 0.38 ($Si = 10^6$). This value is lower than the interpolated iridium abundances of both Suess and Urey and Cameron, but is closer to that of Cameron. Implications of these results are discussed. (auth)

27444 TRITIUM AND ARGON^{39} IN THE BRUDERHEIM METEORITE. St. Charalambus and K. Goebel (CERN, Geneva). Geochim. et Cosmochim. Acta, 26: 659-63(June 1962). (In English)

The T and Ar^{39} contents of the Bruderheim stone meteorite were measured. At the time of fall the average T activity of three different samples of 0.44 count/min per g was obtained. The Ar^{39} was 0.01 counts/min in agreement with measurements in other laboratories. From both pairs, $T-He^3$ and $Ar^{38}-Ar^{39}$, an exposure age of 28 million years ±3 was calculated. This agrees with exposure ages obtained by other methods using Na^{22}, Al^{26}, and Cl^{36}, which yielded a value of 30×10^6 years. (auth)

27445 ON THE PRIMORDIAL GASES IN THE KAPOETA AND STAROE PESJANOE CHRONDRITES. J. Zaehringer (Max-Planck-Institut für Kernphysik, Heidelberg). Geochim. et Cosmochim. Acta, 26: 665-80(June 1962). (In German)

The two chondrites Kapoeta and Staroe Pesjanoe contain high amounts of primordial He, Ne, and A. Primordial He^3 is present with the He^4/He^3 ratio of about 3800. The isotopic composition of primordial Ne has a 30 per cent higher Ne^{20}/Ne^{22} ratio than atmospheric Ne. In the Kapoeta meteorite the primordial rare gases were found to be concentrated in the glass phase only. By degassing the samples in steps at increasing temperatures the primordial gases could be separated from the radiogenic and spallation produced components. From the gas release it is concluded that the primordial gases are mainly trapped in crystal imperfections and that the temperature of these meteorites has always been below 300°C since the gases have been trapped. The relative abundance of all rare gases is in good agreement with the cosmic abundance. This indicates that these gases were trapped from a nearly undifferentiated protoplanetary cloud. (auth)

27446 ABUNDANCE OF U-236 IN NATURE. W. D. Davis and J. L. Mewherter (Knolls Atomic Power Lab., Schenectady, N. Y.). Geochim. et Cosmochim. Acta, 26: 681-4(June 1962). (In English)

Upper limits of less than one part per billion were established by mass spectrometry for U-233, U-236, and U-237 isotopes in uranium from samples of Belgian Congo pitchblende and Colorado carnotite. The new upper limit of one-half part per billion U-236 in the pitchblende is smaller than would be expected from the measured Pu-239 : U-238 ratio of 2.8×10^{-12} in the ore, assuming the Pu-239 was formed exclusively by capture of thermal neutrons; and much smaller than would be expected from previous plutonium assays of Belgian Congo pitchblende samples. (auth)

27447 MINOR ELEMENT DISTRIBUTION IN SEDIMENTARY CARBONATE ROCKS. D. L. Graf (Illinois State Geological Survey, Urbana, Ill.). Geochim. et Cosmochim. Acta, 26: 849-56(Aug. 1962). (In English)

The dependence of the abundances of minor elements in carbonate rocks on the noncarbonate materials, the variety of compounds in which minor elements are incorporated in carbonate rocks, and the mechanisms by which minor elements are transported and localized are discussed. (M.C.G.)

27448 MAGNESIUM ISOTOPIC DISTRIBUTION IN DOLOMITE. A. C. Daughtry, D. Perry, and M. Williams (Humble Oil and Refining Co., Houston, Tex.). Geochim. et Cosmochim. Acta, 26: 857-66(Aug. 1962). (In English)

Dolomite found in nature is generally thought to be either "primary" in origin, or to be the result of diagenesis of pre-existing calcium carbonate sediments, or else formed under different circumstances by both mechanisms. In an effort to elucidate the mechanism of formation of dolomite, attention was given to the evidence which might be provided by the isotopic composition of magnesium in dolomite, partially dolomitized limestones, and limestones. It is possible that study of the magnesium isotopic composition of dolomite and partially dolomitized limestone may indicate whether dolomitization has resulted, in particular cases, from diffusion or pervasion of magnesium salts in solution into pre-existing calcium carbonates. Measurements of magnesium isotope abundances in carbonate rocks in which dolomitization was tectonically controlled indicated that this type of dolomitization may be characterized by a marked variation of magnesium isotopic composition with distance from the location at which the dolomitizing solution enters the rock. This suggests not only that the presence or absence of variation in magnesium isotopic composition may be used to determine whether a particular dolomite is of primary or secondary origin but also that, where the dolomite is found to be secondary, the pattern of variation may reveal the direction in which the invading solution has moved. (auth)

27449 X-RAY INVESTIGATION OF THORIANITES, URANOTHORIANITES AND ALDANITES. E. S. Makarov and I. M. Lipova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 7, 583-9(1962). (In Russian)

An x-ray investigation of seven thorianite, uranothorianite, and aldanite samples from various regions was carried out, and results of chemical analyses are given. For all samples the cubic structure of fluorite type was found, the lattice constants determined increase with the increase of the ThO_2 content from 5.49 to 5.60 Å; the intensities of lines and the interplanar distances are given. The density of the samples was measured, and the crystallochemical formulas of the minerals were calculated. The data confirm the formation of a continuous isomorphic range of UO_2–ThO_2 under natural conditions. The following classification is proposed for minerals of the uraninite-thorianite series: uraninite from 0 to 25 mole % of ThO_2, uranothorianite from 25 to 75 mole % of ThO_2, thorianite–from 75 to 100 mole % of ThO_2. (auth)

27450 ON THE STUDY OF THE LANTHANOID BEHAVIOR IN ALTERATION PROCESSES OF RARE-EARTH MINERALS. D. A. Mineev, B. A. Makarochkin, and A. G. Zhabin (Inst. of Mineralogy, Geochemistry, and Crystal Chemistry of Rare Elements, Moscow and Ural Polytechnic Inst., USSR). Geokhimiya, No. 7, 590-7(1962). (In Russian)

The character of the alteration of lanthanoid composition corresponds to the assumed trend in the process of acidity change of mineral-forming solutions during orthite replacement. As a result of a comparison of concentration coefficients of individual rare earth elements, a conclusion is drawn concerning the considerably higher mobility and ability for concentration of the middle members of the lanthanoid series—Sm, Gd, and Dy—in comparison to its extreme members in some secondary geochemical processes. (auth)

27451 ON THE GEOCHEMISTRY OF RARE ELEMENTS OF LEAD-ZINC DEPOSITS OF THE KLITCHKIN REGION. G. M. Meituv (Inst. of Mineralogy, Geochemistry, and Crystal Chemistry of Rare Elements, Moscow). Geokhimiya, No. 7, 598-609(1962). (In Russian)

The distribution of Cd, In, Tl, Ga, Se, and Te in minerals of the lead-zinc deposits of the Klitchkin region is discussed. (auth)

27452 APPLICATION OF RADIOACTIVITY TO SUBTERRANEAN HYDRAULIC ENGINEERING. R. Hours (Centre d'Études Nucléaires, Saclay, France). Houille blanche, 599-611(June 1960). (CEA-2096). (In French)

The search for radioactive tracers for water capable of percolating through permeable grounds without significant absorption has led to the choosing of two isotopes, bromine-82 (half life 36 hours) and iodine-131 (half life 8 days), both γ emitters; various combinations of other γ emitters with longer half lives have been tried but with only partial success. The recent progress in the dosage of tritium should make it possible to widen the field of application of this tracer. Being detectable at concentrations of 10^{-8} to 10^{-4} curies per cubic meter, the radioactive tracers are suitable for all the usual applications of conventional tracers; furthermore, some original techniques have been devised for measurements of flow, of reservoir capacity, of porosity and of permeability. Techniques based on the absorption and scattering of γ rays have also been developed for the measurement of the density, the humidity and the porosity of soils, and also for their analysis. Up to the present, radioactivity has been mainly applied to the study of oil-bearing formations. Furthermore, the study of the distribution of natural or thermonuclear tritium has contributed greatly to the study of the hydrological cycle. (auth)

27453 RADIOMETRIC SURVEY IN GEOPHYSICAL PROSPECTING. Liboslav Šimon. Jaderná energie, 8: 160-6(1962). (In Czech)

Fundamental characteristics of aerial radiometric methods for surveying radioactive ore, crude oil, and natural gas deposits are given, and of nuclear measuring instruments and their uses. (auth)

27454 DEEP DRILLING AT BASE ROI BAUDOUIN, DRONNING MAUD LAND, ANTARCTICA. E. Tongiorgi (Universita, Pisa, Italy), E. Picciotto, W. de Breuck, T. Norling, J. Giot, and F. Pantanetti. J. Glaciol., 4: No. 31, 101-10(Mar. 1962). (In English)

A drilling operation and core investigations at Base Roi Baudouin (lat. 70°25'53" S., long. 24°18'38" E.) in January 1961 are discussed. The drilling, undertaken with light equipment, attained a depth of 115.72 m. From the start serious difficulties were encountered so that it was decided to use a SIPRE auger driven by the mechanism of the drilling machine. Core recovery was close to 100%. Below a depth of 43.70 m, since the drill had reached the zone of high ice density (0.85 g/cm^3), a 3 m double core barrel was used with air circulation. A depth of 79.33 m was reached with a core yield close to 100%. From this level downwards to the final depth of 115.72 m the core yield was only 55%. Preliminary observations were made at the site. A stratigraphic profile of the first 43 m showed an alternation of coarse-grained summer layers with ice formation and fine-grained winter deposits. From the seasonal alternations of the last six years, an average annual accumulation of 38.3 cm of water was calculated. No colored or dust layers were observed. Between 9 and 16 m and between 41 and 44 m an intense formation of ice was noticed. The depth-density curve is similar to those found by the Norwegian-British-Swedish Antarctic Expedition at Maudheim and by the Americans at Little America V. If an average annual accumulation of 38 cm of water is assumed, the whole

depth drilled corresponds to approximately 240 yr. Temperature measurements could not be carried out because of the limited time available. Detailed stratigraphic and morphological studies of the cores, which are stored at -15°C in Brussels, are planned, as well as chemical and isotopic investigations. (auth)

27455 DETERMINATION OF BETA RADIO-ACTIVITY OF SOME SPRINGS OF THE CÔTES-DU-NORD REGION. URANIUM AND RADIUM CONTENT. J. Pinset and J. Guelfi. J. Radiol., Electrol. Med. Nucl., 43: 307-8 (May 1962). (In French)

Results indicate an important beta radioactivity for numerous springs. The radium proportion appears a little more important than the mean content in France, which is of $4.2 \cdot 10^{-11}$ curies per liter of water. It must be pointed out that the reported determinations are valid for a given sample at the day of collection. In the course of the years 1960 and 1961, the authors have performed repeated determinations for a fair number of springs. Considerable variability, evidenced by the number of counts/minute, corresponds to important falls of rains. The dry periods are followed by lesser activity. (auth)

27456 VARIATIONS OF Sr/Ca RATIOS AND Mg CONTENTS IN RECENT CARBONATE SEDIMENTS OF THE NORTHERN FLORIDA KEYS AREA. Frederic R. Siegel (Univ. of Kansas, Lawrence). J. Sediment. Petrol., 31: 336-42(Sept. 1961).

The amount of strontium in Recent carbonate sediments increases from the Pleistocene reef area of the Florida Keys to the living reef area on the east. The maximum values for strontium contents are reached about one nautical mile on the leeward side of the living reef, and there is a gradual decrease closer to the living reef and seaward from it. Within the same sediments, the magnesium content decreases as the strontium content increases and reaches a maximum where the strontium content reaches a minimum. The high strontium-low magnesium content and the low strontium-high magnesium content are related to the mineralogical nature of the organic remains composing the sediments. (auth)

27457 AGES OF URANINITE FROM TWO BRITISH LOCALITIES. A. G. Darnley (Geological Survey of Great Britain, London), J. H. Smith, T. R. D. Chandler, D. F. Dance, and E. R. Preece. Mineral. Mag., 32: 654-8(Dec. 1961).

Uraninite from Geevor Mine, Cornwall, was analyzed by the complete lead method and an age of 290 ± 7 million years was accepted. Similar studies from Tyndrum Mine, Perthshire, gave an age of 230 ± 8 million years. The significance of the results is discussed. (auth)

27458 AGES OF SOME URANIUM AND THORIUM MINERALS FROM EAST AND CENTRAL AFRICA. A. G. Darnley (Geological Survey of Great Britain, London), J. E. T. Horne, G. H. Smith, T. R. D. Chandler, D. F. Dance, and E. R. Preece. Mineral. Mag., 32: 716-24 (Mar. 1961).

The following ages determined by the complete lead method were accepted for minerals from a number of localities: uraninite, Nkana, Northern Rhodesia, 522 ± 15 million years (m.y.); brannerite, Kansanshi, Northern Rhodesia, 503 ± 15 m.y.; uraninite, Shinkolobwe, Katanga, 642 ± 20 m.y.; davidite, Mavuzi, Mozambique, 578 ± 15 m.y.; monazite, Monkey Bay, Nyasaland, 597 ± 25 m.y.; and samarskite, north-west Kenya, 635 ± 25 m.y. The significance of the results is considered. (auth)

27459 RADIOLOGICAL MONITORING OF OHIO'S WATERS. Ohio's Health, 14: 27-32(Mar. 1962).

It is shown that the level of radioactivity in Ohio's waters is closely related to the amount of fall-out received from nuclear detonation and that other man-made radioactive wastes have not contributed significant amounts of radioactivity. (Public Health Eng. Abstr., 42: No. 8, Aug. 1962)

27460 RADIOCARBON AGES OF POSTGLACIAL LAKE CLAYS NEAR MICHIGAN CITY, INDIANA. Ebhard M. Winkler (Univ. of Notre Dame, Ind.). Science, 137: 528-9 (Aug. 17, 1962).

Two radiocarbon dates were obtained for postglacial clays. One sample, 6350 years old, was taken from a bed of compacted and carbonized wood just above a bed of pebbly clay. Overlying the woody bed is 5½ feet of organic bluish clays and beach sands near the present lake level. The upper clay layer contained a younger wood sample, 5475 years old. The blue clays are of shallow swamp origin and were deposited during the late low-water stage of Lake Chippewa; the pebbly clay is assumed to be of Glenwood age (about 11,000 years) or older. (auth)

27461 GAMMA SPECTROMETRY OF DUST SAMPLES. Martin Sedlacek (Univ. of Vienna). Staub, 22: 87-90 (Mar. 1, 1962).

Dust samples were examined with respect to fission product content by means of a γ spectrometer. It was possible to identify the γ lines in the energy range between 0 and 1 Mev and these are assigned to the following elements: Nd^{147}, Ce^{141}, Ce^{144}, Ba^{140}, La^{140}, Ru^{106}, Ru^{103}, Cs^{137}, Zr^{95}, and Nb^{95}. A method for determination of the absolute γ and β activity from the photo-line surface is described with the aid of a spectrum for an aged dust sample. Quantitative results for dust samples for the months March to May 1959 and April 1961 are presented, and 2 possibilities for determination of the age of the fission product mixture are discussed. (Pub. Health Eng. Abstr. 42: No. 7, July 1962)

27462 METEOROLOGICALLY AND GEOLOGICALLY LIMITED DISTRIBUTION RANGES OF NATURAL RADIOACTIVITY IN AEROSOLS OF THE NORTHERN ALPS FROM THE LATEST MEASUREMENTS. Reinhold Reiter. Z. Aerosol. Forsch. u. Therap., 7: 1-16(Feb. 1958). (In German)

An investigation was made of the variation of natural radioactivity of aerosols in the region of the northern Alps. Meteorological and geological conditions were determined. Methods used in the study are described. Geographic relations are outlined. The dependence of the natural radioactivity of aerosols on wind direction over the Alps was studied. Effects of air moisture, wind velocity, and air pressure are discussed. Results are presented in graph form. (M.C.G.)

HEALTH AND SAFETY

27463 (HW-73654) CONTAMINATION CONTROL AT THE HANFORD LAUNDRY. C. E. Linderoth and G. A. Little (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 11, 1962. Contract AT(45-1)-1350. 6p.

The laundry operation consists of a decontamination laundry, non-regulated laundry service, and a central mask cleaning station. Control of radioactive contamination is accomplished by presorting at the point of use, minimizing handling of contaminated articles, and the discharge of waste effluents under controlled conditions. Procedures are described in detail. (C.H.)

27464 (IDO-12020) RESPIRATORY PROTECTION PROGRAM FOR THE NATIONAL REACTOR TESTING STATION. Bruce J. Held (Idaho Operations Office. Health and Safety Div., AEC) and Loren J. Hueter (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). May 3, 1962. 40p.

All phases of the respiratory protection program at the National Reactor Testing Station were investigated. The review included a usage study of half-face masks, full-face canister masks, and self-contained and in-line breathing apparatus for both the operational and emergency programs. Various masks were evaluated for mechanical leakage and face fitting and adequate equipment was selected based on our particular needs. In conclusion, a proposed operational and emergency respiratory protection program is presented which includes respiratory devices and their limits of usage, training, fitting, care of equipment, and future reviews. (auth)

27465 (NP-11928) HUMAN INTERNAL RADIOISOTOPE DOSIMETRY, INSTRUMENTATION, PROPHYLAXIS AND THERAPY. Annual Progress Report, July 1, 1961–June 30, 1962. Robert M. Heyssel and George R. Meneely (Vanderbilt Univ., Nashville. School of Medicine). June 30, 1962. Contract DA-49-007-MD-995. 84p.

Preliminary experiments with Zr^{95}–Nb^{95} and Ba^{140}–La^{140} were used to determine the body burden and organ concentrations in rats. The biological half time for Ba^{140}–La^{140} was about seven days. Most of the remaining nuclide was in the bone. Equations were derived to determine the amount of Ba^{140}–La^{140}, Zr^{95}–Nb^{95}, and Ru^{103}–Rh^{103m} in the human body using data obtained by whole-body counting techniques. Computer programs to process the data and to provide rapid determination of counting rates under photopeaks of any isotope counted in the steel room were developed. Concentration of intraperitoneally administered Cs^{137} in rats was greatest in gastrocnemius muscle with decreasing concentrations in ilium, kidney, stomach, liver, heart, spleen, lung, and brain. In the Radioactivity Survey Cs^{137} burdens in 659 persons were significantly higher in the white race than in the Negro and in males than in females. Other studies included weekly measurements of Cs^{137} burdens in ten normal subjects, data analysis of potassium content in people, total body potassium during therapy in essential hypertension, isotope labeled Vitamin B_{12} in normal and abnormal subjects, wholebody counting techniques for the determination of absolute absorption of iron, I^{131} accumulation in human thyroid tissue during 1962 U.S.A. nuclear weapon testing, and C^{14} 5-hydroxytryptamine platelet survival. (auth)

27466 (NP-11941) ANNUAL REPORT OF THE NATIONAL INSTITUTE OF NUTRITION, 1961. (Japan. National Inst. of Nutrition, Tokyo). 63p.

Three articles have been abstracted separately in NSA. The remaining articles on nutritional studies in Japan do not pertain to nuclear science. (P.C.H.)

27467 (NP-11941(p.27-9)) THE SURVEY ON THE AMOUNTS OF Sr-90 AND Cs-137 IN JAPANESE DAILY DIETS (REPORT 1). H. Hayami, S. Gotoh, T. Hayakawa, Y. Matsuno, K. Shino, K. Suzuki (Japan. National Inst. of Nutrition, Tokyo), and N. Yamagata (Japan. Inst. of Public Health, Tokyo).

Results of measurements of Sr^{90} and Cs^{137} in Japanese daily diets since 1960 are presented. Measurements were made in August and November. Japan was divided into seven areas and one prefecture was chosen from each area. Then one town and one village were chosen from each prefecture, and ten families were selected from the town and village as subjects of the survey. (P.C.H.)

27468 (NP-11941(p.30-1)) STUDIES ON THE RELATION BETWEEN THE INTAKE OF Ca AND THE EXCRETION OF Sr-90 (REPORT 3). S. Gotoh, T. Hayakawa, K. Suzuki, and H. Hayami (Japan. National Inst. of Nutrition, Tokyo).

Studies were made on the effects of the amount of Ca and Mg in the diet on Sr^{90} excretion in growing albino rats. It was found that the amount of Sr^{90} excreted by rats fed on a high Ca diet was higher than those fed on a low Ca diet. The amount of Sr^{90} excretion in the urine of rats on a high Mg diet seemed higher than those on a moderate Mg diet. The amount of Sr^{90} retained in hard tissues, especially in the femur, was higher in the low Ca group than those of the high Ca group. The Mg content in the diets seemed to have no effect on the retention of Sr^{90} in hard tissues. Data are tabulated. (P.C.H.)

27469 (NP-11941(p.32-3)) LEVEL OF PROTEIN INTAKE AND THE INFLUENCES OF WHOLE-BODY GAMMA RAY IRRADIATION ON RATS. A. Kenmoku and H. Iwao (Japan. National Inst. of Nutrition, Tokyo).

Whole-body gamma irradiation was administered to rats on 8 and 25% casein diets, and the amounts of total nitrogen and allantion excretion in the urine were measured. Total nitrogen excretion was increased by the irradiation. The 8% casein diet fed group was about 60% the normal value the first day, whereas the 25% group was only 20% the normal value. Six days after irradiation, the 8% group showed 5 times the value of the controls, whereas in the 25% casein group the value was 1.3 times. The allantion excretion as a catabolite of nucleic acids was compared with the normal the same as nitrogen. The 8% casein group showed about 60% increase to the normal, but the 25% group represented little increase. It was concluded that high protein diet is significant in preventing gamma radiation injuries. (P.C.H.)

27470 (AEC-tr-5163) MEASUREMENT OF THERMAL NEUTRON DOSAGES. Jean Gigon and Guy Mayer. Translation of French Patent Application. Dec. 5, 1961. 7p.

A method is suggested for measurement of dosages of thermal neutron radiation by means of a body which bends in irradiation. Details of the physical effects responsible for bending are included. (J.R.D.)

27471 (EURAEC-196) THE REMOVAL OF GASEOUS CONTAMINANTS FROM AIR WITH A SORBANT INJECTION SYSTEM. Special Report No. 2. R. Lopes Cardozo and P. Dejonghe (Brussels. Centre d'Étude de l'Énergie Nucléaire). [Oct. 1961]. Work performed under United

States–Euratom Joint Research and Development Program. 18p. A translation of BCH/M005.

Presented at the 7th International Air Cleaning Conference, Brookhaven National Lab., Upton, N. Y., October 10-12, 1961 as TID-7627.

It is shown that a sorbent injection system can be used as a means of cleaning gases from contaminants when low or intermediate decontamination factors are allowed, for instance in closed circuits. The sorbent injection system is composed of a certain pipe length with a sorbent feed system at the head-end and a cyclone, to remove the sorbent from the gas stream, at the tail-end. It is shown that decontaminations of 99% are easily obtainable. (auth)

27472 (FTD-TT-62-42) ON THE DANGER OF FLYING THROUGH A RADIATION FORMING CLOUD. M. Chabowski. Translated from Przeglad Lotniozy, No. 8, 27-31(1960). 8p.

The hazards to aviation personnel flying through atomic clouds are reviewed. No technical data are included. (C.H.)

27473 (JPRS-14449) PREVENTION MEASURES FOR RADIATION SAFETY. N. Yu. Tarasenko, I. G. Prostakova, and N. N. Rynkova. Translated from p.58-103 of "Gigiena Truda pri Rabote na Atomnykh Electricheskikh Stantsiyakh" Moscow, 1960. 31p.

Requirements for radiation protection at atomic power plants are discussed. Topics covered include: protective reactor jackets, establishment of safety zones around reactors, disposition of buildings in the general plan, safety requirements for equipment and control of the reactor, biological protection, ventilation, personal hygiene and methods of individual protection, decontamination, sanitation and living quarters, dosimetry, and technical instruction. (M.C.G.)

27474 ISOTOPIC AGES ON SOME IGNEOUS AND METAMORPHIC ROCKS IN THE VICINITY OF NEW YORK CITY. L. E. Long, J. C. Cobb, and J. L. Kulp (Columbia Univ., New York). Ann. N. Y. Acad. Sci., 80: 1140-7 (Sept. 21, 1959).

The ages of igneous and metamorphic rocks in the New York City area were determined by isotopic techniques. All analyses were made by isotope dilution and mass spectrometric methods. From the data it was concluded that the metamorphism of the New Jersey-New York Highlands began about 1100 to 1200 million years ago. Another regional event occurred about 850 million years ago which recrystallized the mica in the metamorphic rocks of the entire area, but was not of sufficient magnitude to cause serious chemical alteration of the zircon. The latest recrystallization of Manhattan Prong rocks occurred about 365 million years ago. Scattered evidence points to a metamorphic history of these rocks prior to that time. Northeast of the Hudson River where the Highlands were strongly remetamorphosed in Lower Paleozoic time, apparent ages between 1200 and 365 million years were found. (M.C.G.)

27475 POTASSIUM–ARGON DATES ON BASALTIC ROCKS. G. P. Erickson and J. Laurence Kulp (Columbia Univ., New York). Ann. N. Y. Acad. Sci., 91: 321-3 (Apr. 3, 1961).

The applicability of the K-Ar dating to basalts is being studied. The Palisades Diabase sill and its related basalt flows were chosen as the geological units for the study. Argon and most of the potassium analyses were made by the isotope dilution technique. Some of the potassium analyses were carried out by flame photometry. It was concluded that more work is necessary before applying this method to basalts generally. (M.C.G.)

27476 ISOTOPIC AGES FROM NORTHERN NEW JERSEY AND SOUTHEASTERN NEW YORK. Leon E. Long (Columbia Univ., New York). Ann. N. Y. Acad. Sci. 91: 400-7(Apr. 3, 1961).

Studies were made of isotopic ages of rocks in the Manhattan Prong, Reading Prong, and a metamorphosed Cambro-Ordovician sequence in Duchess County, N. Y. Potassium-argon analyses were made. A thorough search revealed no evidence for a metamorphic episode older than a known lower-Paleozoic event. (M.C.G.)

27477 POTASSIUM–ARGON ISOTOPIC AGES ON MICAS FROM THE SOUTHERN APPALACHIANS. J. Laurence Kulp and F. Donald Eckelmann (Columbia Univ., New York and Brown Univ., Providence). Ann. N. Y. Acad. Sci., 91: 408-19(Apr. 3, 1961).

Results are presented as part of a continuing study of the metamorphic-plutonic history of the Blue Ridge and Piedmont Provinces. K-Ar isotopic age studies were made on micas from these rocks. It was concluded that the rocks of the Blue Ridge Province were subjected to repeated metamorphic activity. The initial metamorphism of the basement occurred at least 1100 million years ago. A widespread metamorphism may have affected the area about 850 million years ago. The next clearly defined event took place between 450 and 550 million years ago. At 350 million years ago metamorphism occurred all along the western border of the southern Appalachian Province. This appears to have occurred in a zone at least 100 miles in width. About 250 million years ago, a belt of metamorphism developed in Georgia that may prove continuous through the eastern Piedmont of S. C. and N. C. (M.C.G.)

27478 SOME POTASSIUM–ARGON AGES ON ROCKS FROM THE NORWEGIAN BASEMENT. J. Laurence Kulp (Columbia Univ., New York) and Henrich Neumann. Ann. N. Y. Acad. Sci., 91: 469-75(Apr. 3, 1961).

A reconnaissance survey was made of the K-Ar isotopic ages in mica from representative rock units of the Norwegian basement. Analyses were made by isotope dilution techniques. The results are presented in graphic and tabular form. It was clear that the basement rocks have undergone multiple metamorphism. (M.C.G.)

27479 ISOTOPIC COMPOSITION OF FINNISH GALENAS. Olavi Kouvo and J. Laurence Kulp (Columbia Univ., New York). Ann. N. Y. Acad. Sci., 91: 476-91 (Apr. 3, 1961).

In order to understand the complex metamorphic history of the Pre-Cambrian rocks of Finland, the isotopic compositions of the lead and sulfur were determined in a suite of galena samples chosen to represent the major orogenic or igneous events. These data suggest that the Svecofennidic geosynclinal rocks may have undergone only one major orogenic event at about 1800 million years ago and that the primary sulfide deposition closely followed the plastic deformation, as is observed commonly elsewhere. Similar model ages are obtained for small veinlets in the Karelidic province, but five larger ore bodies give model ages of 2100, and Outokumpu gives 2300 million years. This may suggest an earlier history for the Karelian rocks before 1800 million years or may represent anomalous lead with an unusual crustal environment. Galena-bearing veins in the Rapakivi granite appear to be derived from the underlying shallow basement in Phanerozoic time. (auth)

27480 NOTE ON THE DETERMINATION OF EXPOSURE DOSES RECEIVED BY RADIOGRAPHERS DURING CERTAIN PREOPERATIVE RADIOLOGICAL PROCEDURES. J. Chanteur and J. B. Moroni. Ann. radiol., 5: 371-7(1962). (In French)

From the measurements made under normal working conditions during the x-ray exposure, an attempt was made to assess the order of dosage received by radiographers. Different measurements were made for the primary and secondary rays. It was shown that these doses in the region of certain vital organs could attain a high value when the cassettes are held in the hand for the exposure of laterals. Finally, simple procedures are recalled which do not interfere with the operation and prevent this useless and dangerous exposure: cassette holders for lateral films and the use of a diaphragm and light to define and limit the area to be filmed. (auth)

27481 THE PROBLEM OF CAUSALITY IN ATOMIC LIABILITY LAWS. Berthold Moser (Österreichische Studiengesellschaft für Atomenergie, Vienna). Atomwirtschaft, 7: 249-54(May 1962). (In German)

The atomic insurance laws passed during the last few years follow conventional regulations for questions of liability. However, these laws lack special regulations regarding the proof of causality. The draft of the Austrian Atomic Liability Law devotes special attention to this problem. These regulations are discussed in some detail with a consideration of their possible future development. (J.S.R.)

27482 THE INGESTION OF RADIUM 226 IN FOOD AND WATER IN GREAT BRITAIN. R. C. Turner (Royal Cancer Hospital, London). Brit. J. Cancer, 16: 200-8 (June 1962).

Estimates were made of the average amounts of radium ingested daily in food by individuals belonging to different occupational categories or living in different regions of the country. The estimates show remarkably little variation, the average intake of Ra^{226} being approximately 2-3 $\mu\mu c$ per person per day. The daily intakes of radium from drinking water by individuals in different regions were compared and although the intakes can vary by factors of up to 250 to 1, the absolute amounts of Ra^{226} are so small that in most areas of the country, the contribution made by water represents only 5 or 6% of that made by food. Only in the case of parts of Cornwall does it appear possible for an individual's daily intake of radium from water to exceed that from food. On the assumption that the body may retain approximately equal fractions of the radium ingested in food and water respectively, the findings suggest that the radium burdens of the general population might not cover a wider range than 3 or 4 to 1. Anomalous burdens, higher by an order of magnitude, might however result from long term ingestion of one particular food. (auth)

27483 RADIATION PROTECTION IN THE ATOMIC ENERGY AUTHORITY. THE OPENING ADDRESS TO THE ANNUAL CONGRESS OF THE BRITISH INSTITUTE OF RADIOLOGY, APRIL 26, 1962. William Penney (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Brit. J. Radiol., 35: 510-16(Aug. 1962).

High standards of radiological health and safety depend on careful plant design, carefully considered operating procedures, clearly defined instructions, effective communications, thorough staff training at all levels, good discipline, and efficient supervision, as well as adequate numbers of qualified health and safety specialists. The health and safety organization of the British Atomic Energy Authority is outlined and the safety record is discussed. (C.H.)

27484 SOME PROTECTION ASPECTS IN THE PLANNING OF NEW RADIOTHERAPY DEPARTMENTS. A PAPER READ AT THE ANNUAL CONGRESS OF THE BRITISH INSTITUTE OF RADIOLOGY, APRIL, 1961. B. E. Jones (Radiological Protection Service, Sutton, Surrey, Eng.). Brit. J. Radiol., 35: 517-24(Aug. 1962).

Various aspects of radiation protection are discussed that illustrate the value of, and the need for, planning in the early design stages of a new radiotherapy department. If the various problems which arise can be resolved at that time, and the solutions will to a large extent be dependent upon local conditions, then it will make not only for radiation safety but also for economy and increased efficiency. (auth)

27485 POTASSIUM-ARGON MEASUREMENTS ON THE PALISADES SILL, NEW JERSEY. G. P. Erickson and J. L. Kulp (Columbia Univ., New York). Bull. Geol. Soc. Am., 72: 649-52(Apr. 1961).

A preliminary investigation of the problem of dating basaltic rocks by potassium-argon measurements is described. The Palisades sill was chosen for study. Analyses were by isotope dilution methods, flame photometry, and mass spectrometry. It was concluded that further work on the method is necessary. (M.C.G.)

27486 SHELTERS IN SWEDEN. Odd Albert (Monmouth Coll., West Long Branch, N. J.). Civil Eng., 31: 63-9(Nov. 1961).

Two types of bomb shelters, normal and deep rock, are discussed. The design, construction, and cost of the shelters are emphasized. (Public Health Eng. Abstr., 42: No. 8, Aug. 1962)

27487 FALL-OUT AND FOOD. C. L. Comar (Cornell Univ., Ithaca, N. Y.). Cornell Hotel Restaurant Admin. Quart., 3: No. 1, 75-9(May 1962).

Discussion is given on food contamination from fall-out. It is concluded that present and foreseeable levels of fall-out in food present no reason for changing nutritional habits or food technology. (P.C.H.)

27488 RADIATION DOSIMETRY. Galonska. Ionen u. Elektron., 3: 17-18(Mar. 1961).

The relationship of dose and the effect of ionizing radiation is discussed. The basic concepts (ionic dose or charge dose, the RBW-factor and the unit rem, activity and the unit rem, activity and the unit curie) are defined, and formulas are given for each concept. The dose capacity is determined not only by the factors mentioned above, but also by the time interval during which it is applied. The mean dose capacity is $N = \Delta D/\Delta t$, where N = the mean dose capacity, D = energy dose or the ratio of the absorbed energy to the mass of the irradiated substance, and t = the time interval. Physical measurements are performed with ionization chambers, counting-tubes, and point counters. A circuit diagram for a warning apparatus and dosimeter is given. (OID)

27489 ESTIMATED EFFECT OF NUCLEAR DETONATIONS OF VARIOUS MEGATONS. Energia nuclear (Madrid), 5: 13-16(Oct.-Dec. 1961). (In Spanish)

A survey is made of official American data on the estimated effects of nuclear detonations. The factors discussed are effects of the explosive wave, thermal effects, initial radiation, electromagnetic effects on world communications, local radioactive fall-out, world-wide radioactive fall-out, production of waves, and retinal burns. (J.S.R.)

27490 BIOLOGICAL EFFECTS OF NUCLEAR EXPLOSIONS. Eduardo Ramos Rodriguez. Energia nuclear (Madrid), 5: 17-28(Oct.-Dec. 1961). (In Spanish)

The three principal effects of nuclear explosions are traumatic, thermal, and radiological effects. The incidence of each of these is discussed as a function of the distance from ground zero and protection. (J.S.R.)

27491 ATMOSPHERIC FALL-OUT OF RADIOACTIVE DUST. Eduardo Ramos Rodriguez. Energia nuclear (Madrid), 5: 29-43(Oct.-Dec. 1961). (In Spanish)

Nuclear explosions produce a large number of radioisotopes which are widely dispersed on atmospheric dust particles. These aerosols fall to earth at a velocity dependent on their diameter, and the local intermediate and delayed fall-out is considered. The factors affecting the fall-out rate are reviewed. (J.S.R.)

27492 RADIOACTIVITY OF ATMOSPHERIC DUST. Roman Gonzalez del Campo. Energia nuclear (Madrid), 5: 44-53(Oct.-Dec. 1961). (In Spanish)

The quantitative determination of the activity of atmospheric dust consists of the measurement of the activity per unit volume. Methods for such continuous measurement are briefly described, and the difficulties encountered are summarized. Typical decay curves are shown. Schematic representations of the apparatus for measurement of atmospheric radioactivity are presented. (J.S.R.)

27493 THE BIOLOGICAL EFFECTS OF THE FALL-OUT OF RADIOACTIVE ATMOSPHERIC DUSTS. Eduardo Ramos Rodriguez. Energia nuclear (Madrid), 5: 54-67 (Oct.-Dec. 1961). (In Spanish)

Of the radioisotopes produced in nuclear explosions, only Cs^{137} and Sr^{90} are produced in sufficient quantity and have a half life sufficiently long to produce biological injuries. I^{131} can be of danger if it is precipitated rapidly enough. The biological cycle of Cs^{137} and Sr^{90} which result in their fixation in the body is summarized. Some possible results of the fixation of these three elements in the body are reviewed. (J.S.R.)

27494 AMBIENT RADIOACTIVITY. Margarita Celma Villares. Energia nuclear (Madrid), 5: 68-86(Oct.-Dec. 1961). (In Spanish)

The source of ambient radioactivity, either natural or man-made, is reviewed. The origin and measurement of atmospheric activity, activity in rain water, activity in drinking water, and the activity in biological material such as soil, vegetation, milk, and bones are discussed. (J.S.R.)

27495 IMMEDIATE PROTECTION AGAINST NUCLEAR BOMB EXPLOSION. Eduardo Ramos Rodriguez. Energia nuclear (Madrid), 5: 87-100(Oct.-Dec. 1961). (In Spanish)

The design, construction, and stocking of fall-out shelters are summarized. (J.S.R.)

27496 DECONTAMINATION AS A MEANS OF PROTECTION. D. Emilio Iranzo Gonzalez. Energia nuclear (Madrid), 5: 101-27(Oct.-Dec. 1961). (In Spanish)

Calculation of the maximum permissible concentration of radioisotopes, of the dose emitted, and of the dose received is illustrated as an introduction to a discussion of the contamination produced by a nuclear explosion. The various methods and agents used for surface decontamination, decontamination of drinking water and food, decontamination of clothing, and external and internal decontamination of the body are reviewed. (J.S.R.)

27497 CHEMICAL RADIOPROTECTION IN LIVING ORGANISMS. Carlos A. Davila. Energia nuclear (Madrid), 5: 128-34(Oct.-Dec. 1961). (In Spanish)

A bibliographic survey is made of the problem of chemical radioprotection. The topics considered are radiosensitivity, mechanism of radiolesions, possibilities of radioprotection, chemical radioprotection, and the most important radioprotectors. (J.S.R.)

27498 FALL-OUT AND OUR FOOD SUPPLY. S. Allan Lough. Food, Drug, Cosmetic Law J., 17: 116-21(Feb. 1962).

The path that fission products take to reach food is described, and special emphasis is made of the dietary concern of Cs^{137} and Sr^{90}. Because of the persistency of each as a food contaminant, remedial measures are being sought to reduce the hazard potential. Such techniques as precipitation displacement, ion exchange removal, and chelation are possibilities. Although activity levels in foods are directly related to the rate of fission product deposition, it was concluded that fission product dose will be only 1/10 as great as the Federal Radiation Council Radiation Protection Guide for the general population's bearable risk due to normal peacetime uses of radiation. (Pub. Health Eng. Abstr. 42: No. 7, July 1962)

27499 AN EXPERIMENTAL STUDY OF THE EFFECT PRODUCED ON THE BODY BY ARTIFICIAL DUST MIXTURES (OXIDES OF RARE METALS AND SILICON DIOXIDE). O. Ia. Mogilevskaia. Gigiena i Sanit., 26: 18-24 (Sept. 1961).

Differences in the effect produced by oxides of rare metals on respiratory organs as the result of silicon dioxide admixture were studied. Experiments were performed on white rats and consisted in intratracheal administration of 50 mg of a dust mixture containing 95% of 1 of the rare metal oxides and 5% of SiO_2. Four series of tests were carried out with the following mixtures: $MoO_3 + SiO_2$, $ZrO_2 + SiO_2$, $TiO_2 + SiO_2$, and $WO_3 + SiO_2$. It was discovered that in all instances the admixture of SiO_2 aggravated the effect by the main component of the mixture. In certain instances both the intensity and the nature of the lesion were changed. The results obtained point to the necessity of a more rigid standard for the content of various kinds of dust in the air in instances of possible formation of dust mixtures containing oxides of rare metals in combination with SiO_2 even in small concentrations. (APCA Abstr., 8: No. 2, 1962)

27500 INTEGRATED SYSTEM PROVIDES MECHANICAL, ELECTRICAL SERVICE FOR SURVIVAL SHELTERS. David M. Solzman. Heating, Piping and Air Conditioning, 34: 119-23(June 1962).

A summary of an integrated system of providing mechanical and electrical services for survival shelters is presented and contrasted with all-electric systems commonly considered. (Public Health Eng. Abstr., 42: No. 8, Aug. 1962)

27501 INVESTIGATIONS ON THE ACCUMULATION AND TOXICITY OF RADIUM AND RADIOSTRONTIUM IN THE HUMAN BODY. I. DETERMINATION OF STRONTIUM-90 IN SOME CASES OF CONTAMINATED PERSONS. Pierre Wenger and D. Cassimatis (Institut du Radium, Geneva). Helv. Chim. Acta, 45: 783-9(1962). (In French)

By examination of the urine of some watch dial painters contaminated by strontium-90, a first approximation of the total body burden was made by extrapolating the values obtained during the third phase of elimination. The body burden of highly contaminated persons is found to be of the order of some microcuries, whereas that of less contaminated persons is found to be of some hundredths of microcuries. (auth)

27502 THE PENETRATION OF IODINE INTO BUILDINGS. W. J. Megaw (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Intern. J. Air & Water Pollution, 6: 121-8(Mar.-Apr. 1962). (AERE-R-3827). (In English)

Measurements of deposition of iodine-131 in buildings near Windscale which were made at the time of the incident in 1957 are given together with the results of subsequent experiments on the penetration of iodine into a wooden hut.

It is concluded that, although the deposition of iodine in buildings which are in the path of a fission product cloud will be very much less than that outside, the time integral of volumetric concentration, which determines the quantity of iodine inhaled by people inside the buildings, may be a considerable fraction of that outside. (auth)

27503 SEASONAL VARIATIONS OF STRONTIUM^{90} AND CALCIUM LEVELS IN JERSEY AND HOLSTEIN MILK. Anita A. Jarvis (Univ. of Toronto), J. R. Brown, and D. R. Arnott. J. Dairy Sci., 45: 522-6(Apr. 1962).

Strontium^{90}, calcium, and S.U. levels were studied in the milk of 2 breeds of dairy cows. Samples collected in the spring of 1961 showed a consistently higher level of strontium^{90} and S.U. values than those collected during the summer. A possible explanation for this is that, in the spring, cows were on feed collected in 1960—when levels of fallout were higher than in 1961. There was a considerable difference between the 2 breeds in both spring and summer seasons with regard to calcium and S.U. values, but there was also a significant intrabreed variation. It was noted that both calcium and lactose levels are higher in Jersey than in Holstein milk. The possibility of a bound form of calcium is discussed. (Public Health Eng. Abstr., 42: No. 8, Aug. 1962)

27504 REMOVAL OF STRONTIUM 90 FROM MILK. Sam R. Hoover. J. Milk and Food Technol., 25: 149-52 (May 1962).

Research initiated to develop a standby process for the removal of radioactive contamination from milk is discussed. (P.C.H.)

27505 PRINCIPLE OF A DOSIMETER-INTEGRATOR FOR CYCLOTHERAPY WITH COBALT-60. A. Bercy, J. Défechereux, P. Desaive, J. Garsoux, and G. Thiry (Université, Liegè, France). J. Radiol., Electrol. Med. Nucl., 38: Nos. 5-6(443-4)(1957). (In French)

A dosimeter is described, for use with a cyclotherapy machine that provides a dose rate varying linearly with the thickness of absorbing material between the source and the target (for thicknesses between 4 and 20 cm). It is assumed that the target lies on the axis and in the plane of rotation of the cyclotherapy machine. A small caster supported by a torsion arm glides over the patient's body during the irradiation, in order to monitor the body thickness at the point on which the rays are focused. The torsion arm is connected to a potentiometer and an integrating circuit, which measure the absorbed dose; the operation of the integrating circuit is based on the adjustment of the circuit constants to reflect the known (linear) dependence of the dose rate on thickness from the machine. (T.F.H.)

27506 PROGRESS IN RADIATION PROTECTION. Shields Warren (New England Deaconess Hospital, Boston). New Engl. J. Med., 264: 705-11(Apr. 1961).

The biological effects of radiation are reviewed and sources of radiation exposure are surveyed. It is pointed out that varying needs make it desirable that different standards of protection be applied to patients, workers using ionizing radiation, and the general public. Permissible radiation exposure levels for each group are tabulated. Various means of radiation protection and the effectiveness of each are discussed. (C.H.)

27507 THE HANDLING OF RADIOACTIVE MATERIALS IN THE NONDESTRUCTIVE TESTING OF MATERIALS, IN ACCORDANCE WITH THE FIRST SET OF RULES ON PROTECTION OF RADIATION ISSUED ON JUNE 24th, 1960. P. Midecke. Schweissen u. Schneiden, 13: 470-4(1961). (In German)

Personnel protection in the handling of radioactive materials is discussed. Topics covered include: relation of dose and time of manipulation, protection in permanent installations for nondestructive testing, containers for isotopes, transport equipment, rooms for working with isotopes, limits of the control range, medical monitoring, personnel dose monitoring, obligations of marking, and tests of penetration. (M.C.G.)

27508 FLIGHTS ACROSS RADIOACTIVE CLOUDS. M. Chabowski. Wojskowy Prezegiad Lotniczy, 13: 27-31 (Aug. 1960). (In Polish)

Danger to personnel and equipment arising from radioactive contamination of aircraft after flying across radioactive clouds is discussed. Flights performed 20-30 minutes after an atomic bomb explosion are no longer dangerous. Radioactive dust penetrating into the aircraft constitutes a serious danger. Formation of nitrate in the aircraft decreases the radioactivity. Immediate decontamination of the aircraft upon landing is advised. (Aerospace Med., Vol. 33, Apr. 1962)

27509 PRECIPITATION OF FRAGMENTS BY IRON HYDROXIDE FROM WATER MAINS AND DESORPTION OF THE PRECIPITATE. P. F. Dolgikh. Zhur. Priklad. Khim., 35: 995-1000(May 1962). (In Russian)

The influence of various factors and additives on the precipitation of Sr, Ce, Ru, and Zr-Nb fragments by iron hydroxide and desorption of the fragments from the precipitate were studied at 20 to 60°C. An increase in temperature from 20 to 60° increases Sr precipitation from 30 to 90%. Variations of pH from 7 to 10 effect Sr precipitation but do not effect Ce and Zr-Nb. Potassium salts influence Sr sorption from water by iron hydroxide. A calcium content reduces Sr precipitation to 30% as compared to 94% in distilled water. Additions of 1000 mg/l kerosene do not influence Sr precipitation, but up to 200 mg/l of soap stimulates the precipitation. The results confirm the difference in the mechanism of Sr sorption by iron hydroxide from that of Ce, Ru, and Zr-Nb fragments. (R.V.J.)

27510 RADIOLOGICAL HEALTH DATA MONTHLY REPORT, DECEMBER 1961. Volume II, Number 12. (Public Health Service, Washington, D. C.). 45p. $0.50 (GPO).

Data are tabulated on the radioactivity in samples of air, water, milk, and food other than milk collected throughout the world and analyzed during Dec. 1961. Data are also included on radiation producing machines in New Jersey in 1961, the radioactivity in samples of animal foods analyzed during 1960, and environmental radioactivity during 1961 at Argonne National Laboratory, Atomics International, Canoga Park, Calif., National Lead Co., Fernald, Ohio, and Cape Thompson, Alaska. Data are included on announced nuclear detonations of the USSR and the U.S. during Nov. and Dec. 1961. (C.H.)

27511 THE USE OF FILM BADGES FOR PERSONNEL MONITORING. Safety Series No. 8. Margarete Ehrlich (International Atomic Energy Agency, Vienna). May 1962. 87p. (STI/PUB/43). $1.00(IAEA).

A review is given of common photographic terms and concepts of importance in photographic dosimetry, and the application of the photographic technique to personnel monitoring is discussed. Practical problems of importance in establishing a film-badge service, such as space, equipment, and manpower requirements, are presented along with specific examples of photographic personnel-monitoring procedures as they are now carried out in existing monitoring laboratories. (P.C.H.)

27512 EXPOSURE TO RADIATION IN AN EMERGENCY. Report No. 29. (National Bureau of Standards. National

Committee on Radiation Protection and Measurement, Washington, D. C.). Jan. 1962. 102p. $0.50 (Chicago, Univ. of Chicago).

Consideration is given to possible radiation exposures greatly in excess of those encountered in normal radiation work and, in the case of nuclear war, with the certainty that radioactive fall-out will kill or injure many in the areas involved. Discussion is given on the understanding and application of information and estimates supplied by technical persons and the various aspects of sickness and injury caused by radiation. Attention is focused on the relation between the size of the dose, the seriousness of the effect, and the ultimate outcome. The effects of whole-body irradiation from external sources of gamma radiation and injury to skin by beta radiation are mainly considered. (P.C.H.)

27513 A SLIDE-RULE FOR CALCULATIONS INVOLVING PROTECTIVE SCREENS AND RADIOACTIVE SOURCES. (to Commissariat à l'Énergie Atomique). British Patent 901,502. July 18, 1962.

A slide-rule was developed for performing rapid calculations involving screens needed to protect personnel when radioactive substances emitting gamma radiation or x rays are being handled. On one side of the rule is a family of curves representing the function $\gamma_1 = f(E,X) = kEB_{\mu a}/e^{\mu x}$, where k is a numerical coefficient depending on the units chosen, E represents the energy of the photons, B is the build-up factor, and μa and μ are the coefficients of linear absorption of air and the material of which the screen is made respectively, with γ_1 represented logarithmically along the abscissa, and x linearly on the ordinate. The other side of the rule is logarithmically divided in terms of the radiation intensity R. A moving slider bears the family of curves, in logarithmic coordinates, representing the function $y = r^2/A$, where r is the distance from the source to operator, and A is the activity of the source, y is plotted as abscissa and r as ordinate. (M.C.G.)

27514 IMPROVEMENTS RELATING TO INSTALLATIONS FOR HANDLING OF RADIOACTIVE MATERIALS. (to Babcock & Wilcox Ltd.). French Patent 1,246, 230. Oct. 10, 1960.

In an installation for handling radioactive materials, adapted to the displacement of these materials between an upper and a lower station using a carriage movable on sloping rails in a space enclosed by a biological shielding, a jamming of the carriage may arise. Auxiliary displacement means are described constituting an auxiliary carriage movable on rails parallel to the rails of the main carriage and to place them under a liquid biological shielding. (NPO)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

27515 (AEC-tr-5238) SOME RESULTS AND THE PROSPECTS FOR THE USE OF ISOTOPES AND NUCLEAR RADIATION IN INDUSTRY AND SCIENTIFIC RESEARCH IN THE USSR. P. L. Gruzin. Translated from Atomnaya Energ., 11: 379-94(Oct. 1961). 25p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 3360.

27516 POSSIBLE USES FOR RADIOACTIVE ISOTOPES AND RADIATION IN BEVERAGE PRODUCTION, PARTICULARLY WINE. H. Eschnauer. Atompraxis, 8: 269-72 (July 1962). (In German)

A survey is presented of present methods and future possibilities of using artificial radioactive isotopes and ionizing radiation in beverage research and production, particularly in regard to wine. (auth)

27517 STERILIZATION BY IRRADIATION WITH COBALT-60. A. G. Wilson. Atoomenergie, 4: 124-31 (June 1962). (In Dutch)

In England ionizing radiation is being used at present for sterilization on a commercial scale. A description is given of the installations contributed for this purpose. (tr-auth)

27518 TRANSISTORIZED RADIATION MEASURING APPARATUS FOR γ-RAYS. L. Beug and G. Rudack. Bedrijf en Tech., 16: 137-41(June 24, 1961).

It is often necessary to measure the content of containers which for various reasons cannot be opened or inspected visually, but the γ rays emitted by certain radioisotopes can be used for these measuring purposes because they can penetrate iron walls of from 2 to 100 mm thickness. A level gage is described which consists of a measuring table, a radiation source, a radiation detector, a transformer which converts the incident rays in electric current, a discriminator, a recording device, and an adequate current supply. In principle, there are 2 different measuring methods: one uses 2 counting tubes and determines the level by the difference method, while the other uses only one tube which has been calibrated with a standard source. Several circuit diagrams used in the construction of the devices are discussed. The use of transistors instead of electron tubes is advantageous because they are more compact, sturdier, less dependent on temperature, have a longer life time, and are more economical. A table shows the characteristic properties of one radiation measuring device: 100 pulses/sec, 200 μamp, $-20° - +50°$C, 500-5000 Ω, 12w, counting duration 10^{10} pulses. (OID)

27519 INDUSTRIAL PROSPECTS FOR HIGH ENERGY RADIATION. P. R. Hills (Wantage Research Lab., Berks, Eng.). Chem. Prod., 24: 6p.(Aug. 1961).

The use of radiation to bring about chemical reactions is discussed. Effects of radiation on halogenation, sulfochlorination, nitration, production of glycols, biological materials, sterols, and essential oils are described. (M.C.G.)

27520 γ-RAY PROCESSING OF RICE. (I.) THE EFFECT OF γ-IRRADIATION ON IMPORTED RICE STARCH. Kenichi Takaoka. Hakko Kogaku Zasshi, 38: 88-91(Feb. 1960).

A study of the effect of γ irradiation on imported rice starch showed that the intrinsic viscosity and blue value of starch–iodine color reaction decreased, while the reducing power, alkali liability number, and digestibility increased. A change in the viscogram curve was also noted. Gamma irradiation degraded the straight chain components of the imported rice starch and loosened their strong micell structures. (OID)

27521 γ-RAY PROCESSING OF RICE. (II.) THE EFFECT OF γ-IRRADIATION ON FOOD CHEMICAL QUALITY OF RICE. Akemi Nishimura and Kenichi Takaoka. Hakko Kogaku Zasshi, 38: 615-19(Dec. 1960).

Rice grains from Burma were irradiated by a Co^{60} source up to $10^4 \sim 10^7$ r at room temperature. The grains became slightly yellow-brownish, which increased with increasing dose. Similarly, an unpleasant odor occurred when the grains were boiled. The volume of the boiled rice which was not suitable for meal decreased at dosages above 10^6r. Digestibility studies using diastase showed that irradiated grains were better than the unirradiated grains. Gamma irradiation did not prevent retrogradation. It was concluded that the applicable dose for the purpose is up to 10^5r. (OID)

27522 γ-RAY PROCESSING OF RICE. (III.) SENSORY AND PROPAGATION TESTS OF MICROBES WITH γ-IRRADIATED RICE. Akemi Nishimura and Kenichi Takaoka. Hakko Kogaku Zasshi, 38: 619-23(Dec. 1960).

Further tests on taste and Aspergillus oryzae propagation with respect to irradiation were made. By means of the Bradly method, the irradiated grains were found to be softer than the unirradiated grains. The pH change and reducing sugars were less for unirradiated boiled rice. No clear relationship between the radiation dosage and the power of enzymes produced by the microbes was established. (OID)

27523 γ-RAY PROCESSING OF RICE. (IV.) STUDIES ON THE AVAILABILITY OF γ-IRRADIATED RICE FOR KOJI. Akemi Nishimura and Kenichi Takaoka. Hakko Kogaku Zasshi, 39: 407-10(July 1961).

The availability of rice, γ-irradiated up to 4.6×10^4 and 3.5×10^5r for koji was studied. The enzyme activities of koji of the steamed samples were stronger than the unirradiated rice in amylase and protease. The sensory test on the once-steamed irradiated rice was almost the same as the twice-steamed unirradiated rice. (OID)

27524 MEASUREMENTS OF CLEARANCES BY γ RADIATION. H. Loeffler and W. Altmann (Technische Universität, Dresden). Isotopentechnik, 2: 135-40(May 1962). (In German)

The use of γ radiation for measuring and monitoring clearances from 0.00 up to 3.00 mm is investigated. Three models with different forms and dimensions were used. The results depend on the γ energy of the radioisotopes used, on the geometry of the measuring set-up, and on the beam collimation. (tr-auth)

27525 CONTINUOUS WALL THICKNESS MEASUREMENT ON THIN-WALLED TUBES WITH THE HELP OF BETA RADIATION. Hans Kraechter and Hans-Erich Schloemer. Nukleonik, 4: 180-4(June 1962). (In German)

The thin-walled tubes used for fuel element canning require the observation of narrow wall thickness tolerances.

whose control was made by a continuous testing of the tube length during preparation by β radiation attenuation. The measurement apparatus is described, and the results of preliminary studies on the measurement accuracy, reproducibility of results, and testing speed are reported. Wall thicknesses of 0.1 and 0.2 mm can be calculated with a measurement accuracy of about 5%. With a measurement apparatus modified with respect to the first device and in which unstraight tubes could be tested, more than a hundred tubes were measured without serious trouble. (tr-auth)

27526 DETERMINATION OF DUSTINESS BY THE METHOD OF MEMBRANE FILTERS LABELED WITH RADIOACTIVE NICKEL. G. Kubie and K. Spurny. Pracovní lékařství, 13: 274-7(Aug. 1961).

The preparation of membrane filters labeled with radioactive nickel is described. The red nickel salt of salicylhydrazone salicylaldehyde labeled with Ni^{63} was prepared, the acetone solution of which was added to colloid solutions from which subsequently suitable membrane filters were prepared. Membrane filters thus prepared had an approximate activity of 0.05 $\mu c/cm^2$. The filters were used for retaining various types of industrial dusts and aerosols, in both laboratory experiments and field work. The amount of trapped samples of aerosols and dust particles was estimated by measuring the absorption of soft β irradiation of Ni^{63}. The lower range of sensitivity of the method was 0.2 mg/cm^2 and the range of practical application 0.2-2.0 mg/cm^2. Based on the results, the methods and apparatus are recommended for rapid and automatic assessment of the concentration of dusts and aerosols. (APCA Abstr., 7: No. 10, March 1962)

27527 PROGRESS IN RADIATION PRESERVATION OF FOODS. REPORT OF CONTRACTORS' MEETING. Quartermaster Food and Container Inst., Activities Rept., 13: No. 3, 21p. [1961].

A meeting of contractors in the Quartermaster Radiation Preservation of Foods Project was held in Chicago on June 6 to 8, 1961. The objectives of the project and developments to date were reviewed and future plans were discussed. Research facilities and programs related to the radiation preservation of food in Great Britain and France were outlined. Summaries are included of papers presented at technical sessions covering the biochemistry of sensory changes in meat products, container technology, radiation dosimetry and dose distribution, microbiology of food spoilage organisms, radiation effects on food texture, color, flavor, wholesomeness, and nutritional properties, and the results of feeding irradiated foods to animals and human volunteers. (C.H.)

27528 SNOW MEASUREMENTS WITH RADIOISOTOPES. Wiss. u Fortschr., 11: 473(Dec. 1961).

As is well known, precipitations do not run off immediately during the winter season, but are conserved to a considerable degree in the form of snow. However, warm air current may melt accumulated masses of snow in a very short time causing avalanches and inundations. In order to estimate the magnitude of the accumulated snow, it is necessary to measure the thickness of the snow cover. Such measurements are now being made with radioisotopes. For this purpose, a radioisotope preparation of sufficiently long life is deposited on the ground at the beginning of winter and above it on a high scaffold a radiation detecting device. The detector is connected by a cable to a central counting station. If the radioisotope is a γ emitter, the counter will respond even at a considerable distance from the radiation source. However, this response will become weaker when the snow cover between emitter and detector is large, and the reverse is the case when the snow melts. If sufficient control stations are distributed over the area under investigation, the sudden appearance of dangerous conditions can be predicted. In similar measurements in the Austrian Alps, the arrangement of the emitter and the detector was revised so that the counting device was deposited on the ground, while the radioactive preparation was fixed above it on a long pole. A Pb screen eliminated all radiation except that radiation directly hitting the detector. (OID)

27529 IMPROVEMENTS IN OR RELATING TO MEASURING APPARATUS. David Arthur Walker (to Rolls-Royce Ltd.). British Patent 903,180. Aug. 15, 1962.

A method is given for measuring thickness of material in the form of tubes, solids with holes, or other body shapes where the wall thickness is difficult to measure. The method comprises irradiating the outside surface of the body with alpha, beta, and/or gamma rays, passing a gas at the same time through the cavity within the body, and subsequently measuring the ionization of the gas to give an indication of the material thickness. Beta particles give the most useful range of material thickness, and the ionization may be measured with a Geiger counter or ionization chamber. The method is particularly applicable to hollow turbine blades with cooling holes. (D.L.C.)

27530 IMPROVEMENTS IN OR RELATING TO MEANS FOR DETECTING THE PRESENCE OF UNSAFE WORKING CONDITIONS IN A PROCESS OR EQUIPMENT. Frederick James Burridge and Alan James Towes (to Woodall-Duckham Construction Co.). British Patent 903,713. Aug. 13, 1962.

A modification of the apparatus described in British Patents 801,116 and 801,117 for supervising and controlling the discharge of coke from the ovens of a coke-oven battery is designed. The apparatus utilizes radiation detection to activate a control circuit for advancing the pusher ram to move the coke. The modification comprises at least two detectors, each of which controls an individual control relay in the control circuit, and an auxiliary relay is provided which prevents the "safe" condition from being obtained in the control circuit unless the control relays all change their conditions simultaneously. Thus, the chances of failures leading to false "safe" conditions in the control circuit are reduced. (D.L.C.)

27531 PRODUCING LUBRICATING OILS BY IRRADIATION. Chester L. Read and Peter J. Lucchesi (to Esso Research and Engineering Co.). U. S. Patent 3,043,759. July 10, 1962.

A process is given for producing lubricating oils in high yield from a catalytically cracked hydrocarbon distillate. The process comprises exposing the distillate, comprising predominantly paraffins and a minor amount of olefins, to reactor radiation until >100 Mr equivalent is absorbed. (D.L.C.)

27532 PREPARATION OF GELATIN FROM COLLAGENOUS MATERIAL. John R. Lowry (to General Foods Corp.). U. S. Patent 3,046,210. July 24, 1962.

A method is outlined for extracting gelatin of improved physical properties from collagen-containing materials in shorter times and at higher yields. In this method, the material, e.g., tanners' stock, pigskin, ossein, is exposed to ionizing radiation to a total dosage of 0.5 to 1.5×10^6 rep and then subjected to the usual extraction treatment by soaking in water at 65 to 75°C for several hours. The extracted gelatin, has improved bloom, viscosity, and molecular weight as well as being extracted in higher yield. (D.L.C.)

ISOTOPE SEPARATION

27533 (DP-652) SEPARATIVE WORK AS A PERFORMANCE CRITERION FOR A HEAVY WATER RECONCENTRATION UNIT. William C. Scotten (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1962. Contract AT(07-2)-1. 23p.

The concept of separative work, developed by K. Cohen and I. Kaplan, is used at the Savannah River Plant as a measure of the performance of the process that separates light water from degraded heavy water by vacuum distillation and as the basis for predicting the time required to reconcentrate the backlog of degraded heavy water. The methods of using separative work to achieve these objectives are explained. (auth)

27534 (ORNL-1169) ENRICHMENT OF URANIUM 236. B. Harmatz, H. C. McCurdy, F. N. Case, and R. S. Livingston (Oak Ridge National Lab., Tenn.). Dec. 1951. Contract W-7405-eng-26. 46p.

Neutron irradiated uranium was electromagnetically separated to provide enrichment of U^{236}. The final isotopic abundance was determined to be 95% in 1800 milligrams of uranium. Useful by-products of the program were 22 grams of 25% U^{236} and 1100 grams of 99.7% U^{235}. Possible application of this separation process to recovery of the fuel from the MTR reactor is described. (auth)

27535 (ORNL-3301) PREPARATION OF CHARGE MATERIALS FOR ORNL ELECTROMAGNETIC ISOTOPE SEPARATORS. C. W. Sheridan, H. R. Gwinn, and L. O. Love (Oak Ridge National Lab., Tenn.). Aug. 2, 1962. Contract W-7405-eng-26. 88p.

Descriptions are given of procedures, techniques, and equipment used to prepare charge materials for electromagnetic isotope separators at ORNL. Data on ion outputs during processing, charge consumption rates, and process efficiencies are given for 54 elements. (auth)

27536 (AEC-tr-5207) ISOTOPE SEPARATION IN THE GAS PHASE WITH THE ISOTOPE LOCK (thesis). Hans Udo Wrobel (Christian-Albrechts-Universitat, Kiel). Translated for Oak Ridge Gaseous Diffusion Plant, Tenn. 1960. 43p.

The principles and design of the isotope lock for separating gaseous isotope mixtures are described. The separating effect, the yield, and the weight rate of flow, which are obtained experimentally, are given as a function of pressure and speed. On the basis of the operating manner of the equipment, a theory is developed and utilized for a comparison with experimental results. It was found that the calculated values are not attained experimentally as a result of the relatively simple mechanical construction of the equipment, which is still in the experimental stage. (N.W.R.)

27537 (MLM-1132TR) SEPARATION OF CARBON BY THERMAL DIFFUSION OF METHANE. (Report III). CHARACTERISTICS OF THERMAL DIFFUSION COLUMN OF HOT CYLINDER TYPE AND SEPARATION OF HEAVY CARBON. Sumio Horibe. Translated by George Inouye (Univ. of Dayton) from Nippon Kagaku Zasshi, 80: 11(1959). 20p.

To separate heavy carbon to be used as a tracer, a hot cylinder thermal diffusion column was devised and its characteristics were studied. The hot cylinder of this thermal diffusion column is 375 cm long, 22.24 mm OD, and has a 6.29 mm spacing between the hot and cold walls. The separation factor, which is maximum at 0.76 atm., was 2.67. The result of the comparison between the measured separation factor and the theoretical value calculated from the Jones and Furry theory showed that the correction term K_p, originating from the asymmetry of the apparatus found in the Jones and Furry theory, is unnecessary in calculating the separation factor of this thermal diffusion column. Furthermore, assuming an effective length of the column rather than using the actual length of the column explains the measured separation factor without difficulty. The assumption of an effective length also satisfactorily accounts for the previously reported result of the experiment on thermal diffusion for heavy oxygen. Devising a six-stage cascade system using 14 hot-wall thermal diffusion columns connected in parallel and series, heavy carbon was enriched, using methane as the feed gas. The heavy carbon transport rate was 17.6 cc/day of $C^{13}H_4$, therefore 83 cc per day of methane containing 21.5 per cent C^{13} could be extracted continuously. Moreover, when the heavy carbon was not collected from the bottom of the column, the concentration of the heavy carbon reached 28.2% on the 36th day of operation. (auth)

27538 SEPARATION OF LITHIUM ISOTOPES. I. INCOMPLETE PRECIPITATION OF LITHIUM CARBONATE FROM AMMONIAC ALKALINE SOLUTION. Setsuo Taniguchi, Izumi Shioya, Osamu Toyama, and Teruo Hayakawa (Univ. of Osaka Prefecture). Bull. Univ. Osaka Prefect., Ser. A, 9: No. 1, 59-62(1960).

Isotopic separation factors for the incomplete and slow precipitation of lithium carbonate from ammoniac alkaline solution were measured. Mean separation factors for the 30 to 40 wt % precipitation at 0 and 18°C are 1.015 ± 0.004 and 1.011 ± 0.003, respectively. (auth)

27539 SOME ANALYSES ON THE OPERATION OF WATER RECTIFICATION TOWER. Masami Shimizu and Shinichi Hibino (Keio Univ., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 313-21(May 1962). (In Japanese)

In operating a water rectification tower for the manufacture of heavy water, it generally takes long hours before it is brought to steady operation from start-up. Consequently it is a matter of economical significance how to shorten the required time to reach the steady operation. An analysis was made of the transient accumulating operation for heavy water on the following three processes: (1) enrichment of heavy water by the total reflux method; (2) enrichment of heavy water by the top feed and reflux method; and (3) enrichment of heavy water by the intermediate feed and reflux method. Regarding the steady operation of the water rectification tower, an analysis was carried out on the methods related to the total reflux and drain-out rectification and the continuous rectification. (auth)

27540 IMPROVEMENTS IN OR RELATING TO CENTRIFUGES. Donald Arthur Boyland (to General Electric Co. Ltd.). British Patent 902,301. Aug. 1, 1961.

Centrifuges were designed consisting of rotors arranged for operation at high peripheral velocities and with an improved means of withdrawing the lighter fractions of centrifuged fluid from the rotor. The rotor is provided with at least one radial channel or section connected with the axial part of the main space within the rotor and to an external exhaust chamber so that, when the rotor is rotating, the light fraction of the fluid is evacuated by a centrifugal pumping action in the centrifuge in conjunction with

such normal external pumping as may be necessary. (M.C.G.)

27541 IMPROVEMENTS IN AND RELATING TO CENTRIFUGES. Donald Arthur Boyland (to General Electric Co. Ltd.). British Patent 902,302. Aug. 1, 1962.

A method was developed for separating the heavier fraction from the rotor of a centrifuge by introducing a non-reacting fluid which is much lighter than the relatively heavy fluid fraction into a mixing chamber which rotates with the rotor. The lighter fluid mixes with the relatively heavy fluid and when it is pumped from the mixing chamber draws some of the heavier fluid with it. (M.C.G.)

27542 IMPROVEMENTS IN AND RELATING TO CENTRIFUGES. Donald Arthur Boyland (to General Electric Co. Ltd.). British Patent 902,303. Aug. 1, 1962.

A method was developed for facilitating the withdrawal of fluid from the rotors of centrifuges. In this method the rotor has fixed to it a collecting chamber connected with the interior of the rotor, usually with the axial region, an injector jet arranged to extract fluid from the collecting chamber, an inlet passage for feeding an extracting fluid from an external source to the jet, and an outlet passage through which the mixture of fluid from the interior of the rotor and the extracting fluid can pass to the outside of the centrifuge. The extracting fluid should be readily separable from the lighter fraction from the rotor. (M.C.G.)

27543 IMPROVEMENTS IN AND RELATING TO CENTRIFUGES. Donald Arthur Boyland (to General Electric Co. Ltd.). British Patent 902,304. Aug. 1, 1962.

An improved means was developed for sealing the end plate to the body of a centrifuge rotor. The centrifuge has a hollow body and an end plate which is not integral with it. There is provided between annular surfaces on the end plate and body an annular sealing member of approximately U-shaped cross section. The outer surfaces of the flanges of the member are soldered or otherwise fixed to the annular surfaces on the end plate and body, respectively. The end plate can be detached, when required, by melting the solder, when this is used, or by cutting the sealing member. The sealing member is preferably of thin flexible material such as metal foil. (M.C.G.)

27544 PROCESS FOR THE ISOTOPIC ENRICHMENT OF LITHIUM BY CHEMICAL EXCHANGE. Eichi Saito and Gregoire Dirian (to Commissariat à l'Énergie Atomique). British Patent 902,755. Aug. 9, 1962.

A process is given for the isotopic enrichment of lithium by exchange between a lithium amalgam and an aqueous solution of a lithium salt. The decomposition of the amalgam by the water is prevented from disturbing the total amounts of isotopes (Li^6 and Li^7) in each phase, either by inhibition with a potential difference in the contact apparatus or by compensation in another contact apparatus. (D.L.C.)

MATHEMATICS AND COMPUTERS

Refer also to abstract 28422.

27545 (DP-707) A COMPUTER PROGRAM FOR ECONOMIC STUDIES OF HEAVY WATER POWER REACTORS. James W. Wade (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). May 1962. Contract AT(07-2)-1. 146p.

A computer program for performing the design and cost calculations of a heavy water power reactor plant is described. The program is applicable to a system that produces approximately 300 Mw of electric power, and employs a pressure tube reactor that is cooled with liquid or boiling D_2O and fueled with uranium metal or uranium oxide. Included in the program are an automatic fuel design code in which a liquid-cooled fuel assembly of nested tubes is optimized with respect to a set of engineering criteria, a calculation of the fuel fabrication costs in which it is assumed that a fabrication plant is constructed to supply the fuel for one reactor plant, and a turbine plant optimization in which the operating conditions of the turbine plant are chosen so that the over-all energy costs are minimized. (auth)

27546 (HW-72616) TRIP, A REACTOR KINETICS CODE WITH PARAMETER SEARCH. D. D. Matsumoto and W. L. Stiede (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 27, 1962. Contract AT(45-1)-1350. 26p.

A computer code, TRIP, is described which can be used to solve reactor kinetics equations, heat transfer equations, and specialized reactor rate equations with respect to time. The value of a particular parameter which will effect a given peak in a specified variable can also be determined by iteration. (J.R.D.)

27547 (KAPL-M-GLB-8) STATISTICAL TOLERANCE LIMITS—WHAT ARE THEY? G. L. Burrows (Knolls Atomic Power Lab., Schenectady, N. Y.). May 24, 1962. Contract W-31-109-eng-52. 23p.

Statistical tolerance limits are frequently misunderstood and therefore frequently misused. Specifically, in practice it is frequently not reasonable to assume that normality holds, especially in small lots; so ordinary parametric tolerance limits may not legitimately be used. Moreover, frequently the sampling is not random but rather systematic or stratified random; so the usual tables for neither parametric nor non-parametric tolerance limits apply. This paper contains a brief description of what statistical tolerance limits are, and perhaps more importantly what they are not, together with some examples, short tables, and references to more complete tables to facilitate appropriate choice among various procedures for setting them. In section II a method is illustrated where, by slight modifications, existing tables can be made to yield tolerance limits for stratified samples. The technique will be practically useful when the statistical tolerance interval coverage within strata is high and/or the strata specification tolerances are wide. (auth)

27548 (MND-P-2726) SNAP PROGRAMS. M-1 MONTE CARLO RADIOISOTOPE SHIELDING CODE. Final Report. M. J. Kniedler (Martin Co. Nuclear Div., Baltimore). May 1, 1962. Contract AT(30-3)-217. 164p.

The M-1 code is a Monte Carlo code that applies to cylindrical geometry when solving for the flux from a prespecified radiation source. The source is a gamma and beta emitter and the solution is for the flux of each energy group and of each region of interest in regard to the emitter. A region is a volume of the system bounded by two planes perpendicular to the axis of symmetry and two cylinders (one cylinder if the region includes the axis of symmetry). The code can be used to solve for a maximum of 30 energy groups and 280 regions. The M-1 is coded in Fortran for a 32,000-word 7090 and requires that the energy intervals be prespecified as well as a complete description of the geometry of the system. A specification of materials in the system must also be given. The number of particles to be followed must be specified by the user. Since the technique of splitting can be employed here and so that splitting can occur, a description of the manner in which the system is divided (geometrically) must also be given by the user. A detailed description of the input required by the code is included. The dose per unit volume due to bremsstrahlung gammas for each prespecified region, and due to nonbremsstrahlung gammas for each prespecified region can be computed by the code. The total dose per unit volume for each prespecified region and the number of mean free paths traveled per second in each prespecified region for each energy group can also be computed along with the gamma flux for each prespecified region and for each energy group and the region volume associated with these parameters. (auth)

27549 (SCR-499) ON RICCATI AND RICCATI-LIKE EQUATIONS ARISING IN ONE-DIMENSIONAL DIFFUSION PROBLEMS. I. I. Kolodner, J. Lehner, and G. M. Wing (Sandia Corp., Albuquerque, N. Mex.). Apr. 1962. Contract [AT(29-1)-789]. 32p.

Riccati equations were studied as they arise in diffusion problems. The general behavior of the solutions N(t) for $N' = f(t) - \alpha n - \beta n^2$, $\alpha > 0 \beta \geq 0$, α and β are constants and $N(0) = c > 0$ was studied. The linear case $\beta = 0$ was examined. General considerations, shape of solution curves, estimates of $t(\beta)$, and upper and lower bounds were investigated for $\beta > 0$. A generalization for the equation is also given. (M.C.G.)

27550 (TID-16238) TECHNICAL PROGRESS REPORT. PART I. CIRCUIT RESEARCH PROGRAM. PART II. ILLIAC USE AND OPERATION. PART III. IBM 650 USE AND OPERATION. PART IV. INSTRUCTIONAL USE OF COMPUTERS. PART V. CONTROL DATA CORPORATION 1604. PART VI. 7090-1401 COMPUTING SYSTEM. PART VII. GENERAL LABORATORY INFORMATION. (Illinois. Univ., Urbana. Digital Computer Lab.). Apr. 1962. Contract [AT(11-1)-415]. 49p.

Computer research and development progress is reported. Topics covered include: circuit research, Illiac use and operation, IBM 650 use and operation, instructional use of computers, control data corporation 1604, 7090-1401 computing system, and general laboratory information. (M.C.G.)

27551 (WAPD-TM-294) APPLICATIONS OF THE SIMPLIFIED SPHERICAL HARMONICS EQUATIONS IN SPHERICAL GEOMETRY. Ely M. Gelbard (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1962. Contract AT(11-1)-Gen-14. 7p.

The simplified spherical harmonics equations are derived in spherical geometry. With the aid of the spherical harmonics equations in simplified form, it is shown that

the main mode eigenvalue of a bare spherical reactor is equal to the second mode eigenvalue of the equivalent slab, provided that only P-0 and P-1 scattering components are present in the sphere. The equivalent slab is a bare slab having a thickness equal to the diameter of the sphere, and a composition which is the same as that of the sphere. (auth)

27552 (AEC-tr-5200) PRESENT STATE OF PRODUCTION AND OF THE MARKET OF URANIUM^{235} AND OF HEAVY WATER. S. Villani. Translated for Oak Ridge National Lab., Tenn. from Energia nucleare (Milan), 9: 213-25(Apr. 1962). 36p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 20936.

27553 THE NUMERICAL SOLUTION OF COUPLED INTEGRODIFFERENTIAL EQUATIONS. M. M. Pennell and L. M. Delves (Massachusetts Inst. of Tech., Cambridge). Math. Computation, 15: 243-9(July 1961).

A method is reported for the numerical solution of simultaneous integro-differential equations. The method can be programmed for computers. It has been tested on a problem arising in nuclear physics, the results of which were reasonable. (J.R.D.)

27554 EVALUATION OF THE ZEROS OF CROSS-PRODUCT BESSEL FUNCTIONS. L. Jackson Laslett and William Lewish (Iowa State Univ., Ames and E. I. du Pont de Nemours & Co., Wilmington, Del.). Math. Computation, 16: 226-32(Apr. 1962).

Characteristic solutions were derived for Bessel's equation $J_n(qa)Y_n(qb) - J_n(qb)Y_n(qa) = 0$ or $J'_n(qa)Y'_n(qb) - J'_n(qb)Y'_n(qa) = 0$ in the interval $a \leq r \leq b$ for the first Dirichlet root and the first two Neumann roots. Analytic formulas are given, and characteristic functions are tabulated for $(b - a)/(b + a) = 0.001$, 0.01, and 0.1. The results are available in greater detail in a report. (D.L.C.)

27555 CHAMBER'S SOLUTION OF THE BOLTZMANN EQUATION. Herbert Budd (Ecole Normale Supérieure, Paris). Phys. Rev., 127: 4(July 1, 1962).

It is shown that Chamber's kinetic integral is an exact solution of the Boltzmann equation in the relaxation time approximation. (auth)

27556 THE PROBLEM OF MASTER EQUATIONS. L. Van Hove (Institut Theoretische Fysica der Rijksuniversiteit, Utrecht). Rend. Scuola Intern. Fiz. "Enrico Fermi," 14: 155-69([1961]). (In English)

The master equation approach to the ergodic problem is discussed. The quantum master equation was derived under the assumption of random phases at the initial time only. The system consisting of one conduction electron interacting with the phonon gas in a harmonic lattice was considered. The use of the resolvent and the case of small perturbation are discussed. (M.C.G.)

27557 HANDBOOK OF STATISTICAL TABLES. D. B. Owen (Sandia Corp., Albuquerque, N. Mex.). This Book is in the Addison-Wesley Series in Statistics. Reading, Massachusetts, Addison-Wesley Publishing Company, Inc., 1962. 592p. $12.50.

Over 100 different tables are included on functions used in statistics. (N.W.R.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstracts 28379 and 28520.

27558 (BMI-X-195) DEVELOPMENT OF NIOBIUM-BASE ALLOYS FOR USE IN A NUCLEAR SUPERHEATER. Quarterly Progress Report for January–March 1962. John A. DeMastry and Arthur A. Bauer (Battelle Memorial Inst., Columbus, Ohio). Apr. 1, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 8p. (EURAEC-350)

Activities in a program to develop Nb-base alloys for use as cladding and/or structural materials which are corrosion resistant to steam at 1000 to 1300°F are reported. Several Nb-base alloys were fabricated to 0.050-in.-thick sheet at room temperature and at 800°F. Data concerning fabrication behavior are tabulated. Thin corrosion specimens were annealed at 2200°F before corrosion testing. Results of 2 days exposure to 1000°F 1500 psi steam indicated that Zr additions are detrimental to corrosion resistance. (J.R.D.)

27559 (NP-11963) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Karen Barnes, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). June 1962. Contract AF 33(616)-7747. 56p.

References (120) on defense metals and materials are given to journals and reports published from September 1961 to May 1962. Separate author, subject, and DMIC numerical indexes are included. (P.C.H.)

27560 (NP-11964) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Karen Barnes, comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 1962. Contract AF 33(616)-7747. 41p.

Seventy-three references on defense metals and materials are given to reports and journals published from January 1962 to June 1962. Separate author, subject, and DMIC numerical indexes are included. (P.C.H.)

27561 (NUMEC-P-41) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Monthly Progress Letter for Month of April 1962. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). May 18, 1962. Contract AT(30-1)-2389. 4p.

Emphasis during the period was placed on sintering studies of PuO_2 and on high density feed material production for eventual swaging and vibratory compaction studies. Spheroidization by plasma torch to increase density was also studied. In PuO_2 preparation studies, the highest densities were obtained by air sintering. Preparation of PuO_2 powders by ultrasonic attrition is being studied for a pretreatment step. Data on densification of granular U are tabulated along with data on impurities. (J.R.D.)

27562 (TID-16019) INTERMEDIATE-TEMPERATURE OXIDATION OF BERYLLIDES. Monthly Letter Report No. 8, April 1, 1962 to May 1, 1962. Frank C. Perkins (Denver. Univ. Denver Research Inst.). May 8, 1962. Contract AT(11-1)-1092. 12p.

Activities in a program to study oxidation kinetics and characteristics of $ZrBe_{13}$, Zr_2B_{17}, $NbBe_{12}$, and Nb_2Be_{17} at 1200 to 1800°F are reported. Data from gravimetric experiments performed on nominal $ZrBe_{13}$ and Zr_2Be_{17} materials are tabulated. Oxidation curves are included. Effort was also devoted toward investigation of an observed metallographic manifestation which might help explain disintegration phenomena related to beryllide materials. A very fine grain boundary precipitate was detected in nominal $ZrBe_{13}$ and Nb_2Be_{17} materials after prolonged heat treatment in the intermediate sensitive temperature range. The location of a precipitate found at the junction of the $ZrBe_{13}$ and Zr_2Be_{17} phases suggests that one of these phases may have a higher solubility for a suspected impurity (probably O) than the other phase. Preliminary metallographic study of nominal Zr_2Be_{17} material which was annealed in the sensitive temperature range revealed no major internal precipitation. This was interpreted to indicate that the Zr_2Be_{17} Phase has greater solubility for the impurity. Stoichiometry may therefore have some influence on the mechanism of disintegration in view of the partitioning of the impurity between the two phases. (J.R.D.)

27563 (TID-16111) DIFFUSION IN SOLIDS. Progress Report and Publication List. David Lazarus (Illinois. Univ., Urbana). June 1, 1962. Contract AT(11-1)-1102. 40p.

Diffusion in b.c.c. transition metals is being studied. Experiments in progress are concerned with the diffusion of Fe and Nb in Ti–Fe alloys. The diffusion of Nb in this system exhibits a marked minimum at 4 at.% Fe. Other activities in this area include a survey of the literature on diffusion in transition metals and plans for future work. Measurements are in progress to determine the effects of hydrostatic pressure on the formation rates of F centers in NaCl, KCl, and KBr at liquid H, liquid N, and room temperatures. Results of preliminary runs are included. Work is continuing to measure directly the divacancy concentrations in Au wires quenched from high temperatures. Plans for nuclear magnetic resonance studies are outlined. Several aspects of quenched resistivity are being studied in Au. (J.R.D.)

27564 (TID-16379) RAPID QUENCHING OF LIQUID ALLOYS. Technical Report No. 7. Pol Duwèz and R. H. Willens (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). July 1962. Contracts AT(04-3)-221 and Nonr-220(30). 15p.

A technique is described by which metastable alloy phases can be obtained by very rapid cooling from the liquid state. The results obtained so far have lead to; extension of solubility limits beyond their equilibrium values, new phases not found under equilibrium conditions, and amorphous alloys. (auth)

27565 (UNC-5003) CARBIDE FUEL DEVELOPMENT. Progress Report, September 15, 1961 to December 31, 1961. A. Strasser (United Nuclear Corp. Development Div., White Plains, N. Y.) and K. Taylor (Carborundum Co., Niagara Falls, N. Y.). Feb. 9, 1962. Contract AT (30-1)-2899. 35p.

Single phase, solid solution, UC-PuC powder was synthesized reproducibly from a mixture of the oxides and carbon. A simple method of monitoring the reaction was developed. UC-PuC-0.1 wt % Ni pellets of 93% theoretical density were made reproducibly, with some samples as high as 95% of theoretical density. The pellets contain minor amounts of $(U,Pu)_2C_3$ most of the time. Efforts to make reproducible 95%, single-phase material are under way. Microprobe analysis of UC-0.1 wt % Ni specimens was completed. A second phase apparently promoted by the

nickel was shown to be probably U_2C_3. Essentially all the nickel was found in solution in the matrix UC. The post-irradiation examination of the UC specimens completed to date showed that the UC pellets had the same appearance after irradiation as before irradiation. Their dimensional changes were very slight (1.4% volume increase). Fission gas release was low and within the sensitivity of the initial measurement (3.5% max). The average specimen burnup was 18,500 MW-d/tonne at an average maximum fuel temperature of 760°C (1400°F). The plutonium facilities continued satisfactory operation at zero contamination level. (auth)

27566 (UNC-5013) CARBIDE FUEL DEVELOPMENT. Progress Report, January 1, 1962 to March 31, 1962. A. Strasser (United Nuclear Corp. Development Div., White Plains, N. Y.), and K. Taylor (Carborundum Co., Niagara Falls, N. Y.). May 28, 1962. Contract AT(30-1)-2899. 28p.

Reproducibly high density UC-PuC pellets containing minor amounts of $(U,Pu)_2C_3$ were made with nickel sintering aid. Average densities of 95% and maximum densities of 96.6% of theoretical were obtained. High density, single-phase UC-PuC pellets were made by sintering at high temperatures. Densities of 94% of theoretical appear to be attainable. Improved identification of microstructural constituents was made by means of metallography, x-ray diffraction, and microprobe analysis. Development of specialized chemical analysis techniques continued. The post-irradiation examination of the UC specimens was completed. Mass spectrometer analysis showed that 0.4% of the fission gases was released. Metallographic examination of the UC did not reveal any changes in structure. Metallographic examination of the metal specimen parts that were in contact with UC was completed. No evidence for interaction with niobium and slight evidence for interaction with stainless steel was found. The latter was not deleterious. Perturbation factors were calculated for the UC-PuC experiments. Negotiations continued, in order to select the most suitable test reactor. (auth)

27567 (JPRS-13977) MODERN METAL PHYSICS AND THE PROBLEMS OF MODERN TECHNOLOGY. E. (Ye.) M. Savitskii (Savitskiy). Translated from Vestnik Akad. Nauk S.S.S.R., 32: No. 3, 24-34(1962). 16p.

A review of the present status of metallurgy and alloy development is presented. General terms are used to describe methods and results. The need for more intensive systematic research is pointed out especially in the double-alloy and more complex systems. (J.R.D.)

27568 REACTION OF COLUMBIUM WITH OXYGEN IN THE TEMPERATURE RANGE 400 TO 1325C (752 TO 2417F). T. L. Kolski. Am. Soc. Metals, Trans. Quart., 55: No. 1, 119-34(Mar. 1962).

The oxidation kinetics, appearance of outer scale and underlying metal, and metallography of the metal-oxide interface were studied. (D.L.C.)

27569 THE POSSIBILITY OF PREPARING LAMINAR ALLOYS OF IRON–ALUMINUM BY DIFFUSION OF THE ALUMINUM INTO FERROUS ALLOYS. Christian Messager and Eugene Herzog. Compt. rend., 254: 2978-9(Apr. 16, 1962). (In French)

A study was made on the preparation of laminar Fe–Al alloys be diffusion of aluminum into steel. Steel samples with and without the addition of Ti, Nb, and Zr, in the form of platelets, were covered with a thin layer of Zn and clad with Al by immersion in a fused melt at 675°C. The results showed that Ti and Nb favor a regular diffusion of the Al and prevent localized dissolution and the distortions caused by diffusion irregularities. The steels containing Nb and Ti after 2 hr at 1100°C show no concentration gradient, and the alloys appear perfectly homogeneous. The alloys obtained in this manner have higher plasticity properties than those prepared by fusion. The mechanical properties of a diffusion alloy containing 24% Al are tabulated. (J.S.R.)

27570 EFFECTS OF RADIATION ON METALLIC CORROSION. J. J. Stobbs (Central Electricity Generating Board. Nuclear Labs., Berkeley, Gloucester, Eng.). Met. Revs., 7: 95-131(1962).

A review on the radiation effects on metallic corrosion is presented. The problem of expressing the rate of irradiation is considered briefly. Radiation effects on the metal itself, on the protective layer, and on the corrodant are discussed in detail. The corrodants considered include gases, aqueous solutions, organics, liquid metals, and fused salts. (D.L.C.)

27571 RELEASE OF IODINE-131 FROM IRRADIATED URANIUM OXIDIZING IN AIR AND IN CARBON DIOXIDE. W. J. Megaw and J. E. Bridges (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 195: 448-9 (Aug. 4, 1962).

A study was made of the connection between oxidation and I^{131} release in irradiated U at 800°C, under conditions where only gaseous I^{131} is released. The experiments were continued for several hours after oxidation was complete. In air, U oxidizes to U_3O_8 and a maximum of 50% of the I^{131} is released, both processes coming to completion after 1.5 hr. In CO_2, U oxidizes to $UO_{2.37}$ in 1 hr, while no I^{131} is released in this period. As heating continues, the U oxide loses O_2 and begins to release I^{131}, and after several hours is $UO_{2.6}$; after 6 hr, 70% of the I^{131} has been released. (D.L.C.)

27572 VACUUM BRAZING OF METALS. J. Lapujoulade (Centre d'Études Nucléaires, Saclay, France). Vide, No. 95: 207-28(1961). (CEA-2001). (In French)

Brazing in vacuum was studied for application for the making of containers and apparatus meant for high vacuum ($p < 10^{-8}$ torr). The wettability of a brazing alloy on a metal is defined and the influence of the various parameters which act on this wettability (nature of the solid, of the liquid, geometrical and physicochemical state of the surface, metallurgical reactions occurring at the interface, temperature, time) is discussed. Results are given of the tests carried out in order to determine the conditions of wettability in vacuum of some brazing alloys on metals which can be used for the above mentioned apparatus (stainless steel, aluminium, bronze, titanium, zirconium, kovar, nickel, copper). (auth)

27573 PREPARATION OF BORON BY REDUCTION OF BORON HALIDES BY HYDROGEN. L. A. Nisel'son, I. V. Petrusevich, F. I. Shamarai, and T. F. Fedorov. Zhur. Priklad. Khim., 35: 984-8(May 1962). (In Russian)

The reduction of boron halides by hydrogen on heated surfaces was studied, and the effects of temperature and H_2: BBr_3 ratios on various boron modifications were determined. (R.V.J.)

27574 IMPROVEMENTS IN AND RELATING TO THE TREATMENT OF GRAPHITE FOR PROPERTY MODIFICATION. John Sidney Robinson, Derek Leonard Biggs and Jerzy Sebastian Jakub Glass (to English Electric Co. Ltd.). British Patent 900,568. July 11, 1962.

A method and an apparatus are described for preparing graphite with increased density and decreased gas permeability. In this method, graphite is heated in a furnace to effect sublimation. (D.L.C.)

27575 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF BERYLLIUM METAL. Robert Derek Crook, Derek Geldart, and James Malcolm Alexander (to United Kingdom Atomic Energy Authority). British Patent 900,698. July 11, 1962.

A process is given for producing Be metal from $Be(OH)_2$. The process comprises converting the hydroxide into oxide briquettes, chlorinating the briquettes, and passing the $BeCl_2$ vapor through a packed column in contact with a depleted $BeCl_2$–NaCl melt from an electrolysis stage, whereby the deplated melt becomes enriched in $BeCl_2$ and may be returned to the electrolysis stage for Be production. Equipment for the process is described. (D.L.C.)

27576 SOLUTIONS AND PROCESSES FOR THE PRODUCTION OF CHEMICAL CONVERSION COATINGS UPON ZIRCONIUM AND ITS ALLOYS. (to Amchem Products, Inc.). British Patent 900,825. July 11, 1962.

Chemical conversion coatings may be produced on Zr and its alloys by means of all-acid aqueous solutions containing phosphoric and fluoboric acids with a combined total concentration of 10 to 150 ml/l and in a ratio from 0.5 to 10:1. Addition of small amounts of stannous and/or molybdenum ions to the solutions results in the production of heavy, coarse coatings. Zirconium coated in this way and subsequently treated with a hot solution of alkaline phosphates and/or silicates may be cold-worked without galling. (D.L.C.)

27577 IMPROVEMENTS IN OR RELATING TO MAGNESIUM BASE ALLOYS. Philip Andrew Fisher and Edward Frederick Emley (to Magnesium Elektron Ltd.). British Patent 901,324. July 18, 1962.

It was found possible to incorporate both zirconium and aluminum in the same magnesium-base alloy in such a manner as to obtain a fine grain size even with less than 2% aluminum present and to produce wrought articles which are resistant to grain growth at elevated temperatures. The alloy consists of magnesium plus 0.25 to 10% by weight aluminum and from 0.1 to 0.7% zirconium. The method of preparation consists in flowing together two streams of molten magnesium alloys, one with aluminum and the other including zirconium, casting the combined stream, and chilling it quickly. (M.C.G.)

27578 IMPROVEMENTS IN OR RELATING TO MAGNESIUM BASE ALLOYS. Philip Andrew Fisher and Edward Frederick Emley (to Magnesium Elektron Ltd.). British Patent 901,325. July 18, 1962.

A method was developed for incorporating both zirconium and aluminum in a magnesium alloy in such a manner as to obtain a fine grain size even with less than 2% aluminum present. Wrought articles were produced from this alloy that are resistant to grain growth at elevated temperatures. It was found possible to include other zirconium precipitating elements instead of or in addition to aluminum. Preparation consisted of the flowing together of two streams of molten magnesium-base alloys one of which included the zirconium-precipitating element or elements and the other which includes zirconium, casting the combined stream, and chilling it quickly. By this means at least some of the solid crystal nuclei derived from the molten zirconium alloy remain undissolved and so initiate crystallization and at least some of the precipitated zirconium-compound particles are retained in suspension in the alloy. (M.C.G.)

27579 PRODUCTION OF ZIRCONIUM AND HAFNIUM OXIDES IN A FLUIDIZED BED. William Hughes and Arthur Wallace Evans (to British Titan Products Co. Ltd.). U. S. Patent 3,043,656. July 10, 1962.

A process is outlined for producing ZrO_2 and HfO_2 from their chlorides on a large scale. In this process, the chlorides are reacted with O_2 at ~1000°C in a fluidized bed of, e.g., zircon sand. Reactors for use with the process are described. (D.L.C.)

27580 PLUTONIUM ALLOYS CONTAINING CONTROLLED AMOUNTS OF PLUTONIUM ALLOTROPES OBTAINED BY APPLICATION OF HIGH PRESSURES. Reed O. Elliott and Karl A. Gschneidner, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,043,727. July 10, 1962.

A method of making stabilized plutonium alloys which are free of voids and cracks and have a controlled amount of plutonium allotropes is described. The steps include adding at least 4.5 at. % of hafnium, indium, or erbium to the melted plutonium metal, homogenizing the resulting alloy at a temperature of 450°C, cooling to room temperature, and subjecting the alloy to a pressure which produces a rapid increase in density with a negligible increase in pressure. The pressure required to cause this rapid change in density or transformation ranges from about 800 to 2400 atmospheres, and is dependent on the alloying element. (AEC)

27581 SELF-MODERATING FERTILE COMPOUNDS. David T. Peterson and Joachim Rexer (to U. S. Atomic Energy Commission). U. S. Patent 3,044,847. July 17, 1962.

Thorium carbide-x-(thorium hydride), where x is an integer from 1 to 2, are prepared by reacting thorium monocarbide and thorium at 500 to 950°C in a hydrogen atmosphere. (AEC)

27582 METHODS OF PREPARATION OF ELEMENT 95. Glenn T. Seaborg and Ralph A. James (to U. S. Atomic Energy Commission). U. S. Patent 3,044,944. July 17, 1962.

A process of making americium by bombarding plutonium or uranium with neutrons or deuterons and aging the mass for decay of the plutonium formed to americium is described. The americium may then be separated by dissolving the mass in aqueous acid and carrier precipitation of the americium, especially on lanthanum or cerous fluoride. (AEC)

27583 PRODUCTION OF URANIUM MONOCARBIDE. R. M. Powers (to U. S. Atomic Energy Commission). U. S. Patent 3,046,090. July 24, 1962.

A method of making essentially stoichiometric uranium monocarbide by pelletizing a mixture of uranium tetrafluoride, silicon, and carbon and reacting the mixture at a temperature of approximately 1500 to 1700°C until the reaction goes to completion, forming uranium monocarbide powder and volatile silicon tetrafluoride, is described. The powder is then melted to produce uranium monocarbide in massive form. (AEC)

27584 BRAZE BONDING OF COLUMBIUM. R. L. Heestand and M. L. Picklesimer (to U. S. Atomic Energy Commission). U. S. Patent 3,046,650. July 31, 1962.

A method of brazing niobium parts together is described. The surfaces of the parts to be brazed together are placed in abutting relationship with a brazing alloy disposed adjacent. The alloy consists essentially of, by weight, 12 to 25% niobium, 0.5 to 5% molybdenum, and the balance zirconium. The alloy is heated to at least its melting point to braze the parts together. The brazed joint is then cooled. The heating, melting and cooling take place in an inert atmosphere. (AEC)

27585 PRODUCTION OF METALS. Lloyd R. Allen, Charles A. Baer, and Philip J. Clough (to National Research Corp.). U. S. Patent 3,049,421. Aug. 14, 1962.

A process is given for producing high-purity, extremely

fine metal powders having a particle size less than 0.1 μ. The method comprises evaporating a metal from the group Al, Mn, Ag, Cr, Be, Cu, B, Si, Fe, Ni, Zn, Mg, Ti, Zr, Th, and Bi at a pressure below 500 μ, condensing the vapors in free space, and collecting the powder in a non-oxidizing or inert medium. Examples of the process are described for producing Al and Ni powders. (D.L.C.)

Corrosion

Refer also to abstracts 28420 and 28558.

27586 (AI-Memo-6416) EXPERIMENTAL APPARATUS AND TECHNIQUES FOR HIGH TEMPERATURE COMPATIBILITY STUDIES. W. T. Smith (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 31, 1961. Contract [AT(11-1)-Gen-8]. 11p.

The development of apparatus and laboratory techniques for the study of materials compatibility with 1500 to 2200°F potassium was attempted. Techniques for corrosion tab preparation, dry box capsule filling and sampling, and vacuum filling and sampling are described. Apparatus for rotating capsule testing to 2000°F, rotating capsule testing to 2400°F, and anisothermal "see-saw" capsule testing is also described. (auth)

27587 (ARF-2227-6) HIGH-TEMPERATURE OXIDATION PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS. Final Report, June 12, 1961–July 11, 1962. John J. Rausch and F. C. Holtz (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Aug. 1, 1962. Contract NOw 61-0806-c. 69p.

More than forty coating materials were investigated for the oxidation protection of V–Nb alloy sheet specimens at 2000 to 2400°F and above. The wide range of coatings included flame-sprayed ceramics, roll-bonded Fe–Cr–Al, slurry-coated or fused Zn, Al, Ni, and other alloys, liquid-phase sintered chromium-noble metal alloys, sintered intermetallic compounds, and pack-cemented diffusion-type coatings. The most promising system studied was a diffusion-type silicide applied to V–1 wt % Ti–60 wt % Nb by a pack cementation process. This coating afforded excellent protection for at least 1000, 290, and 50 hours in static air at 2000, 2200, and 2500°F, respectively, and a remarkable capacity for tolerating defects was noted. Silicide-coated specimens withstood exposure to an oxyacetylene flame for 4 hours at temperatures up to 2800°F, and tensile and stress-rupture tests in 2000°F air showed no degradation of properties of the vanadium alloy base. Nickel, flame-sprayed on V–1 wt % Ti–60 wt % Nb, could be exposed directly to elevated-temperature air, and the coating life was 150 and 50 hours at 2000 and 2200°F, respectively. A glassy phase which developed during exposure may have contributed to the ability to seal over defects for lengthy periods. As flame-sprayed, the composites could be plastically deformed, but the coatings became relatively brittle after Ni–V–Nb compounds formed at elevated temperatures. The alloy Fe–25 wt % Cr–5 wt % Al roll-bonded to V–5 wt %–20 wt % Nb was protective for about 50 hours at 2000°F; good bonds were not obtained on the higher-Nb alloy. Greatly reduced coating life (<5 hours at 2000°F) was measured for most of the other systems studied. In most cases, coatings survived much longer on V–1 wt % Ti–60 Nb than on the vanadium-rich alloy. (auth)

27588 (ASD-TDR-62-203(Pt.1)) KINETICS OF OXIDATION IN THE Mo-Si SYSTEM. Joan B. Berkowitz (Little (Arthur D.) Inc., Cambridge, Mass.). Mar. 1962. Contract AF33(616)-6154. 42p.

The oxidation behavior of Mo, Mo_3Si, Mo_5Si_3, and $MoSi_2$ was studied at temperatures between 1000 and 1725°C at oxygen partial pressures less than 20 mm. Pure molybdenum metal oxidizes linearly in this range, with a ratio constant $k = k_0 1^{-22,000/RT} p^{0.97}$, where p is oxygen partial pressure, the gas constant R is in cal/mole, T is in °K, and k_0 is a constant independent of temperature and pressure. To a good approximation, oxidation of the molybdenum silicides follows a logarithmic rate law, $Q = Q_0(1-1^{-\alpha t})$, where Q is the total oxygen consumed between time zero and time t, while Q_0 and α are constants, dependent upon composition, pressure and temperature. In general, for a given silicide composition, Q_0 decreases and α increases with increasing temperature between 1300 and 2000°K, at a constant oxygen partial pressure. At any fixed temperature, the most oxidation resistant material is $MoSi_2$; Mo_5Si_3 is oxidized to a larger extent before a protective coating is established, and Mo_3Si is oxidized still more extensively. It is significant, however, that the rates of oxidation of all three compounds eventually reaches a low-limiting value. Metallographic examination of the oxidized samples established that oxidation proceeds at least in part by diffusion of oxygen inward. (auth)

27589 (BM-RI-5990) CHEMICAL AND GALVANIC CORROSION PROPERTIES OF HIGH-PURITY VANADIUM. Charles B. Kenahan, David Schlain, and Walter L. Acherman (Bureau of Mines. College Park Metallurgy Research Center, Md.). July 1961. 22p.

Vanadium is subject to only light corrosion in phosphoric acid at temperatures up to 60°C and has a moderate corrosion rate in this acid at 100°C. It is relatively corrosion resistant in sulfuric and hydrochloric acids up to 60°C but corrodes rapidly at 100°C. It corrodes rapidly in dilute nitric acid at 35°C. Vanadium is almost inert in 10% solutions of formic, acetic, lactic, tartaric, and citric acids; in 9% oxalic acid it corrodes slowly up to 60°C and rapidly at 100°C. Vanadium is resistant to corrosion in substitute ocean water, tapwater, and in 3% sodium chloride and 10% sodium hydroxide solutions. It is readily attacked by 20% ferric chloride, 20% cupric chloride, and 5% mercuric chloride solutions. Vanadium is protected by contact with magnesium, aluminum, and steel SAE 4130 in substitute ocean water, by magnesium and aluminum in 3% sodium chloride solution, and by magnesium in tapwater. Vanadium protects copper in substitute ocean water. When vanadium and stainless steel are coupled in sulfuric acid solutions, both metals are usually unaffected by contact, whereas the corrosion rate of titanium in sulfuric acid is greatly reduced by contact with vanadium. (auth)

27590 (DRI-2043) AN INVESTIGATION OF THE EFFECT OF METALLIC ADDITIONS UPON THE OXIDATION RESISTANCE OF $NbAl_3$. Quarterly Progress Report No. 2, March 1, 1962–May 31, 1962. Ronald L. Wells, Donald T. Klodt, and Charles E. Lundin (Denver. Univ. Denver Research Inst.). June 1962. Contract AT(11-1)-1092. 33p.

The effect of Ti, Zr, V, Sn, and Si additions upon the oxidation resistance of the intermetallic compound, $NbAl_3$, was studied in an oxidation rate survey at 760°C in wet and dry air. The oxidation characteristics of $NbAl_3$ were greatly enhanced by titanium additions of 10 wt % or greater, tin additions of greater than 4 wt %, and silicon additions of greater than 4 wt %. Zirconium has a detrimental effect on $NbAl_3$ oxidation, and over 15 wt % vanadium must be added for significant oxidation resistance. Alloys containing 53.5 wt % Nb–46.5 wt % Al ($NbAl_3$), 53.5 wt % Nb–36.5 wt % Al–10 wt % Ti, 31.75 wt % Nb–53.25 wt % Al–15 wt % Ti, 51 wt % Nb–44 wt % Al–5 wt % Sn, and 51 wt % Nb–44 wt % Al–5 wt % Si were further investigated in a thermogravimetric apparatus at 760, 860, 960, 1060, and 1160°C.

The activation energy of oxidation was determined where applicable. (auth)

27591 (EURAEC-284) CORROSION PROBLEMS. Quarterly Report No. 8, January–March 1962. (Brussels. Centre Belge d'Etude de la Corrosion; Brussels. Centre d'Etude de l'Energie Nucléaire; and Brussels. Société d'Etudes, de Recherches et d'Applications pour l'Industrie). Mar. 1962. Work performed under United States–Euratom Joint Research and Development Program. 33p.

Development of an electrolysis cell which allows for microscopic inspection during corrosion tests is reported. Construction and auxiliary materials including polystyrene, alumina, and an electric cable were irradiation tested along with a nylon latex alumina cell. Reports are being prepared on stainless steel corrosion by chlorides. Chronopotentiometric studies of Fe and Zr are reported. Reactor radiation tests on stainless steel in $KHCO_3$ resulted in very little variation from tests without radiation. Aluminum was corrosion tested in $(NH_4)_2HPO_4$-NH_4NO_3 systems; an increase in passivation under irradiation was noted. (J.R.D.)

27592 (HW-SA-2454) CORROSION OF X-8001 ALUMINUM AND Zr-2 UNDER CONDITIONS OF HIGH HEAT TRANSFER. R. J. Lobsinger (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 27, 1962. Contract AT(45-1)-1350. 11p.

A description is presented of work done in an ex-reactor recirculation loop to determine the value of the temperature drop across adjacent water and corrosion product films for X-8001 Al and Zircaloy-2 cladding materials. Tests of X-8001 Al were conducted at 600 and 660°F in 3200 psig water. The Zircaloy-2 test is unfinished, and is being conducted at 280,000 Btu/hr-ft^2 at 580°F. Data on the X-8001 tests are included. (J.R.D.)

27593 EFFECT OF RESIDUAL ETCHANT ON THE CORROSION BEHAVIOR OF ZIRCALOY-2. Stanley Kass (Westinghouse Electric Corp., Pittsburgh). Corrosion, 7: 566t-70t(Dec. 1961). (WAPD-T-1095)

The aqueous corrosion behavior of Zircaloy-2 surfaces contaminated with reaction product from the HNO_3-HF-H_2O etchant was studied. Surfaces slightly contaminated with residual etchant exhibited cloudy surfaces and corroded more rapidly than non-contaminated surfaces. The surfaces of coupons severely contaminated exhibited white continuously spalling oxide films in high temperature water. In 750°F steam, however, the corrosion was characterized initially by a spalling corrosion film followed by an adherent corrosion product. (auth)

27594 CORROSION OF STAINLESS STEEL TUBES BY LIQUID SODIUM SYSTEMS. II. RESULTS AND DISCUSSION FOR THERMAL CONVECTIONAL CORROSION TEST. Hideo Atsumo (Hitachi Ltd., Japan). Nippon Genshiryoku Gakkaishi, 4: 281-7(May 1962). (In Japanese)

A newly formed thermal convectional testing apparatus in high-temperature NaK was used. NaK was circulated at a comparatively low flow rate in the time range from 500 to 1,500 hr at 600°C. The inner wall of the specimen tubes was examined by microscopic examination. The results are as follows: (1) The shapes of inward deposited metals in tubes are the most important fact in this case. (2) At a low flow rate, there are no changes for steel compositions or welding methods after long exposure testing. (3) With the lapse of exposure time, microstructure of the specimens differ slightly from original state (especially deposited metal parts). (auth)

27595 ZASHCHITA MOLIBDENA OT VYSOKOTEMPERATURNOI GAZONOI KORROZII. (Protection of Molybdenum Against High-Temperature Gas Corrosion). A. I. Borisenko. Moscow-Leningrad, Publishing House of the Academy of Sciences, USSR, 1960. 84p.

A systematic account is given of published data on Mo and Mo alloy protection from corrosion by high-temperature gases. Various coating materials and coating techniques are discussed and evaluated. 81 references are included. (R.V.J.)

Fabrication

Refer also to abstract 28507.

27596 (ASD-TR-7-882(VII)) HIGH ENERGY RATE EXTRUSION. Interim Technical Progress Report No. 7-Phase II, April 1, 1962–July 31, 1962. J. M. Rippel (Westinghouse Electric Corp. Materials Mfg. Div., Blairsville, Penna.). Aug. 1962. Contract AF 33(600)-41948. 56p.

Ten foot extrusions of Ti-6Al-4V were made. Eight feet of steel and twelve feet of aluminum also were made. Extrusions were of the Tee configuration, 2 inch by 1 inch by 0.050 inches thick. Surface finish was good, 100 RMS and tolerances of ±0.005 inches were maintained. Some of the effects of die entry angle on the high energy rate extrusion process were determined. Details of this investigation are presented. A description of the extrusions made and the braking devices is also given. (auth)

27597 (BM-RI-6025) EXPERIMENTAL PRODUCTION OF LIGHTWEIGHT BASIC REFRACTORIES. M. E. Tyrrell (Bureau of Mines. Norris Metallurgy Research Lab., Norris, Tenn.). Sept. 1961. 19p.

Lightweight basic refractories suitable for use in some sections of the all-basic furnace were developed. Potential advantages of such refractories are lower weight, improved resistance to thermal shock, and less tendency to spall off the working face. Plant trials in positions not subject to heavy loading or severe erosion seem warranted. Forsterite ($2MgO \cdot SiO_2$), stabilized dolomite ($2CaO \cdot SiO_2 + MgO$), and chromespinel [$(Fe,Mg)O \cdot (Cr,Al)_2O_3$] refractories were fabricated using bubbles as the principal component in the brick mixtures. Bubbles were blown from melts of the basic raw materials as they were tapped from a conducting-hearth arc-resistance furnace. The bubbles were graded, bonded with synthetic forsterite plus mineralizers, dry-pressed, and fired to temperatures of 1600°C or over in a gas-fired kiln. Refractory properties of the bubble brick were compared with those of insulating refractories made by burning combustibles out of dense brick mixtures. Lightweight refractories fabricated of bubbles were one-third lighter in weight than dense bricks of like materials. Their mechanical strength was satisfactory, and their resistance to thermal shock was excellent. In tolerance to open-hearth slag and in resistance to thermal shock, the chrome-spinel bubble bricks were the best of the refractories tested. Basic refractories of the insulating type were about 40% lighter in weight than dense commercial refractories, but they were mechanically weak and not suitable for superduty service. (auth)

27598 (CRFD-1094) THE GAMMA-PHASE EXTRUSION OF SMALL DIAMETER URANIUM BARS. G. C. Weston (Atomic Energy of Canada Ltd., Ottawa) and J. A. Perry (Canada. Dept. of Mines and Technical Surveys). June 1962. 32p. (AECL-1544)

A series of tests were conducted to establish the feasibility of producing high quality uranium bars directly from as-cast billets by gamma-phase extrusion. The tests, which were run on both horizontal and vertical presses, were su-

cessful and bars were extruded with a surface finish of 32 to 64 rms micro-inches and good dimensional tolerances (0.315 in. ± 0.003 in.). A review is also given on the published literature on the techniques employed in metal heating and handling, die materials, extrusion pressures and speeds, and the use of glass lubrication. The value of the extrusion constant K found in the horizontal tests was 5600 psi. The high carbon content of the metal used is thought to be the reason for the high K value obtained. The value of K found in the vertical extrusion tests, which were run at the same nominal temperature as the horizontal tests, was 9130 psi. The reason for the higher K value is thought to be that the actual extrusion temperature was approximately 200°C lower than the nominal temperature. (auth)

27599 (CRFD-1100) AN ELECTRON MICROSCOPE STUDY OF THE SINTERING OF URANIUM OXIDE POWDER COMPACTS. A. M. Ross and J. L. Whitton (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1962. 19p. (AECL-1563)

Electron microscopy revealed the changes in microstructure that occurred in UO_2 powder compacts sintered in hydrogen for two hours at various temperatures between 790 and 1655°C. Sintering at temperatures up to 930°C caused no important changes in either the size or the shape of the powder particles. After sintering at 1070°C, most particles assumed more definitely polyhedral shapes, but still did not increase in size; the shape change was attributed to the growth of necks between particles. General particle growth (grain growth) occurred in the compacts sintered at the next highest temperature, 1155°C. The growth was markedly nonuniform, and, in compacts sintered at still higher temperatures, appeared to result in the retention of groups of small grains with numerous intergranular pores surrounded by a matrix of relatively large grains with a few intragranular pores. The islands of high porosity were thought to be the origin of relatively large pores located mainly at the intersections of grain boundaries in the compacts sintered at 1655°C. Possible causes for the uneven grain growth were considered. Of these the variation in particle size and presence of agglomerates in the original powder were believed important. (auth)

27600 (CW-R&DL-24) ANNUAL REPORT ON BERYLLIUM RESEARCH. 1961. W. D. Bennett (Canadian Westinghouse Co., Ltd. Research and Development Labs., Hamilton, Ont.). Feb. 1962. For Atomic Energy of Canada, Ltd., Chalk River, Ont. 66p. (AECL-1555)

Studies were conducted on the high temperature mechanical properties of hot- and warm-extruded beryllium rods. The warm-extruded rod showed greater susceptibility to heat treatment. Joining methods studied were brazing, electron beam welding, fusion welding by argon arc, and pressure welding. Fusion welding by argon arc and pressure welding gave the most satisfactory results for end-cap welding on beryllium tubes and were adopted in the fabrication of burst test specimens. Tube evaluation on any scale was confined to Pechiney hot-extruded tubing and Brush warm-extruded tubing. Burst tests on the Pechiney material gave scattered results attributed to micro-cracks and chloride inclusions. Warm-extruded tubing gave consistenly reproducible results representing high hoop stresses. It was shown by x-ray diffraction studies that certain compounds could be either precipitated or retained in solution by suitable heat treatments. The changes in mechanical properties with heat treatment were presumed to be due to the degree of precipitation which had occurred. (P.C.H.)

27601 (LAMS-2716) HIGH DENSITY W–UO_2 BY ACTIVATED SINTERING. W. H. Lenz and P. R. Mundinger (Los Alamos Scientific Lab., N. Mex.). May 1962. Contract W-7405-eng-36. 31p.

Activated sintering of Ni-doped W powders in hydrogen was confirmed at temperatures as low as 1100°C. The presence of considerable UO_2, however, causes the Ni additive to lose much of its effect. The relative merits of Ni and/or TiO_2 additives as activators in W-50 vol % UO_2 mixtures were investigated with regard to particle size and sintering cycle. At a temperature of 1700°C some of these W-50 vol % UO_2 compositions could be sintered to near theoretical density in 1 to 4 hr. The effect of hydrogen and vacuum atmospheres on the sintered density of these materials was compared to similar effects observed with W and Re powders. (auth)

27602 (MAB-139-M(C3)) STATE OF THE ART ON CASTING. Progress Report No. 3. (National Research Council. Materials Advisory Board). June 10, 1962. 42p.

The present state of the art on castings is reviewed and developments under way or anticipated which will advance the process growth potential for the 1965-1980 period is examined. The forming of materials into dimensionally controlled configurations of interest to the aerospace industry is considered. (P.C.H.)

27603 (MAB-181-M) REPORT OF THE SUBPANEL ON COATINGS—REFRACTORY METALS SHEET ROLLING PANEL, MATERIALS ADVISORY BOARD. (National Research Council. Materials Advisory Board). June 1, 1962. 63p.

Information and recommendations concerning protective coatings for sheet alloys of Mo, Nb, Ta, and W are presented. These protective coatings are being developed to meet requirements of the sheet rolling program. It is noted that there are so few data available on properties of coatings that a coating cannot be recommended for use in the sheet rolling program. The coating panel plans to formulate criteria against which coatings can be evaluated, and developers will be invited to disclose the performance of their coatings against the criteria established. (J.R.D.)

27604 (NMI-2602) DEVELOPMENT OF TECHNIQUES FOR THE EXTRUSION OF BERYLLIUM TUBING. R. N. Randall and F. M. Yans (Nuclear Metals, Inc., Concord, Mass.). June 30, 1960. Contract AT(30-1)-1565. 20p.

Three sizes of tubing were produced: 0.40 × 0.03, 0.75 × 0.03, and 0.75 in. OD × 0.10 in. wall. Two methods of extrusion were used. In one, the filled billet method, the hollow beryllium core in the extrusion billet was filled with a steel filler that was removed after extrusion. In the other method, a hardened steel mandrel was used to form and control the ID of the tube. Extrusion billets were prepared from the starting material, Brush–200 mesh QMV powder, in three ways: powder was packed cold into the extrusion billet can; powder was packed cold into a can, pre-extruded, and machined into extrusion billet cores; and powder was packed cold into a can, hot compacted, and machined into extrusion billet cores. The latter method was used for most of the extrusions. The production of the small-size tubing, 0.4 in. OD × 0.03 in. wall, was studied the most extensively. (P.C.H.)

27605 (NOR-62-25) PROGRAM FOR THE DEVELOPMENT OF EXTRUDED BERYLLIUM SHAPES. Final Technical Engineering Report, April 20, 1958–December 31, 1961. L. M. Christensen and R. R. Wells (Norair. Div. of Northrop Corp., Hawthorne, Calif.). June 1962. Contract AF 33(600)-36931. 317p. (ASD-TR-62-7-644).

Techniques by which aircraft and aerospace structural shapes of unalloyed beryllium can be extruded to a wall thickness of 0.060 in. ±0.001 in. are given. Pilot produc-

tion of five twenty-foot long extrusions demonstrated good dimensional integrity and surface quality for structural channels 1.50 in. wide and 1.00 in. high. To produce extruded beryllium shapes of aircraft quality, the development of lubrication, die materials, heating, die design, and the effect of variable press speeds were investigated. It was determined that composite lubrication of metallic and liquid (nonglass) lubricants is better adapted to utilization with beryllium than is bare glass lubricated extruding. It was also determined that: flat faced dies are best for the glass lubricant approach while a conical entrance is best for composite lubricants; fillet radii as small as 0.03 in. radius can be produced in beryllium; the tensile ultimate strength and elongation of the 0.06 in. thick extrusion increases from a low at the front end of the extrusion up to values at the back similar to those found for other thickness extrusions. Tensile properties were quite uniform in the 0.120 and 0.080 in. thickness extrusions. (auth)

27606 (SCNC-305) FEASIBILITY STUDY FOR DIRECT ROLLING OF BERYLLIUM POWDERS. Final Report Covering Period From April 15, 1959 to November 30, 1959. K. H. Moyer and I. Sheinhartz (Sylvania-Corning Nuclear Corp., Bayside, N. Y.). Jan. 1960. Contract NORD-17017. 42p.

The feasibility of making beryllium sheet by the direct rolling of beryllium powder was demonstrated. A green strip was formed by passing beryllium powder through a rolling mill. The green strip was subsequently sintered in argon or vacuum, rerolled, and annealed to form a fully dense beryllium sheet. Properties of the material made by sintering in an argon atmosphere were essentially the same as those of the vacuum sintered material; however, in the former material, there was considerably less loss of material due to vaporization. The finished sheet had a tensile strength of approximately 49000 psi and an elongation of 0.2%. It is believed that the low ductility was mainly due to the thinness of the sheet. The maximum finished thickness was 0.008 in. X-ray diffraction tests indicated that the final sheet had a random structure.

27607 (AERE-Trans-883) POWDER SINTERING AND EXTRUSION FOR THE FABRICATION OF U–Al AND UO_2–STAINLESS STEEL DISPERSION FUEL ELEMENTS. L. Meny, J. Buffet, and C. Sauve. Translated by J. V. L. Hopkins (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Plansee Proc., 4th Seminar Reutte/Tyrol, 1961. 30p.

Uranium–aluminum and uranium dioxide-stainless steel extruded reactor fuel tubes fabricated by sintering are described with respect to the methods used. The methods allow direct manufacture of dispersion fuel tubes to exact dimensions and very good fuel-sheath contact. At present tubes may be 2 m long, 20 to 30 mm in diameter with wall thickness from 2 to 5 mm. Characteristics and properties of the tubes are presented and discussed. (N.W.R.)

27608 (FTD-TT-62-273) METAL WORKING OF HEAT RESISTING ALLOYS. LECTURE COURSE IN METAL WORKING, EQUIPMENT AND HEAT TREATMENT OF METALS. M. L. Bernshtein (Bernshteyn). Translated from p.40-50 of "Kurs Lektsii po Metallovedeniyu, Oborudovaniyu i Tekhnologii Termicheskoi Obrabotki Metallov, Metallovedenie Zharoprochnykh Splavov" Moscow, 1959. 15p.

Included in the lecture is information on plastic deformation mechanisms, methods of increasing strength, role of interatomic bonds, and the future developments in the metallography of heat-resistant alloys. Discussion of alloy phases is also included and favorable effects of cold deformation. (J.R.D.)

27609 BERYLLIUM INTERMETALLIC COMPOUNDS—THEIR PREPARATION AND FABRICATION. D. A. Mansur and J. P. Smith (General Electric Co., Cincinnati). J. Metals, 14: 575-8(Aug. 1962).

Various means of preparing and fabricating beryllium intermetallic compounds, primarily $ZrBe_{13}$ and $CbBe_{12}$ were investigated in an attempt to provide material for use in determining the effects of impurities and fabrication on their properties. Vacuum distillation and arc-melting techniques were employed to supplement powder processing and provide control material. Improvements in the vacuum-hot-pressing process increased the reproducible yield to satisfactory billets. Small cast shapes were produced by arc-melting and casting techniques, and the feasibility of extruding $ZrBe_{12}$ by co-extrusion techniques was established. (auth)

27610 JOINING DISSIMILAR METALS. Donald Peckner (High Temperature Materials, Inc., Brighton, Mass.). Materials in Design Eng., 56: 115-22(Aug. 1962).

General rules and precautions that were developed for joining dissimilar metals are discussed. The following metallurgical factors which must be considered in the joining process are described: thermal cycling and shock, galvanic corrosion, metallurgical stability, compatibility of base metals, and dilution by base metal. Rules for brazing and soldering are given. A table of 170 dissimilar metal joints is presented. (M.C.G.)

27611 ACTIVATED SINTERING OF NIOBIUM CARBIDE. P. S. Kislyi, A. D. Panasyuk, and G. V. Samsonov (Inst. Metal-Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., No. 2, 38-43(Mar.-Apr. 1962). (In Russian)

A description is given of the activated sintering of niobium carbide with additions of Fe and $CoCl_2$. Experimental data are presented on sintering, and the processes occurring during sintering are discussed. (auth)

27612 THE JOLT-PACK FABRICATION OF SPECIAL CERAMIC WARE. F. W. Calderwood, D. R. Wilder, and H. A. Wilhelm (Ames Lab., Ames, Iowa). Proc. Iowa Acad. Sci., 68: 202-21(1961). (IS-159)

The jolt-pack method for fabrication of refractory crucibles and other shapes is described. The particle size distribution of the material to be packed was found to be an important consideration in this method. Data are presented on packing densities of various graded fractions of beryllia and the development of a dense-packing mixture is described. (auth)

27613 "BAROMETRIC" INVESTMENT CASTING OF URANIUM. H. Ollier (Centre d'Etudes Nucleaires, Saclay, France). Rev. mét., 59: 547-51(June 1962). (In French)

Uranium and its alloys are melted in a vacuum and then cast in sealed quartz or graphite moulds. The filling of the mould is carried out under pressure; argon at 4 to 10 kg/cm^2 is used, according to the rod sizes which are to be produced. (auth)

27614 EXTRUSION AND DRAWING OF ZIRCONIUM. J. Thévenet (Commissariat à l'Énergie Atomique, Saclay, France) and J. Buffet. Rev. mét., 59: 553-61(June 1962). (In French)

Extrusion of zirconium or Zircaloy-2 by the Ugine-Sejournet process makes it possible to obtain sections which are similar to those produced at present in steel. The drawing is greatly facilitated by using thin stock. (auth)

27615 NEUTRON-ATTENUATING MATERIAL. Angel Alberto Bianco (to Imperial Chemical Industries Ltd.). British Patent 902,799. Aug. 9, 1962.

A method is outlined for producing neutron radiation

shields on site, e.g., reactor shields. The method comprises packing a hollow shape with discrete chips of a solid material containing ≥3 wt % hydrogen and filling their interstices between the chips with a matrix containing ≥3 wt % hydrogen. The chips may be polyethylene, nylon, or polyethylene terephthalate, and the matrix may be mineral oil, water, a silicone fluid, etc. The chips may also contain B or Cd for absorbing the neutrons and heavy elements for absorbing gamma rays. (D.L.C.)

27616 VULCANISATION OF SILICONE RUBBER. (to Dow Corning Corp.). British Patent 903,201. Aug. 15, 1962.

A commercially feasible method is outlined for vulcanizing silicone rubber stocks with the aid of high-energy ionizing radiation. The method comprises a combined treatment of high temperatures (100 to 400°C) and radiation and is applicable to stocks based on siloxane polymers having an average of 1.95 to 2.01 organic radicals/Si atom. The minimum radiation dosage is quite low, 0.1 Mrad at 200°C and 0.3 Mrad at 100°C. (D.L.C.)

27617 IMPROVEMENTS IN OR RELATING TO A GRAPHITE OR CARBON ARTICLE. (to U. S. Atomic Energy Commission). British Patent 903,260. Aug. 15, 1962.

A method is given for treating a carbon body to produce a carbon article with decreased gas permeability and increased resistance to corrosion and erosion. The method comprises coating the body with a composition containing one or more of the elements Zr, Mo, Ti, Nb, and Si or heat-decomposable compounds thereof in a solvent, and heating the coated body to a diffusion temperature for forming carbides of the elements in situ in the body. The coating composition may also contain an organic thickening agent and an organic binding agent. (D.L.C.)

27618 HIGH DENSITY, SOFT PHOSPHATE GLASS AND METHOD OF MAKING IT. (to Corning Glass Works). British Patent 903,450. Aug. 15, 1962.

A method is given for fabricating a phosphate glass which is especially suitable for use as radiation shielding windows because it has excellent transparency, does not darken or accumulate electrical charge with radiation exposure, and may be melted in massive articles at low temperatures. The glass consists of 26 to 51 mole % P_2O_5, 33 to 56 mole % H_2O, and a total of 12 to 26 mole % of PbO, HgO, and/or Tl_2O. The maximum P_2O_5 + H_2O content is 70 wt %, and other oxides such as ThO_2, Al_2O_3, etc., may be added in amounts up to 5 mole %. The melting process is described in some detail; the containers must be Pt or non-silica-containing refractories. The molten phosphate glass is poured into a glass container for use as the cooled phosphate glass is attacked by moisture. (D.L.C.)

27619 GRAFT COPOLYMERS AND PROCESS FOR PRODUCTION THEREOF. (to E. I. du Pont de Nemours and Co.). British Patent 903,566. Aug. 15, 1962.

A process is given for preparing novel graft copolymers of olefin–SO_2 polysulfones on solid organic polymers. The process comprises contacting an olefin–SO_2 mixture with a preformed solid substrate of an organic polymer of a molecular weight ≥5000 and activated by 100 rad to 20 Mrad of ionizing radiation of energy ≥100 ev. The properties of the resulting polymers are improved over these of the original solid polymer. Examples of the process are given. (D.L.C.)

27620 IMPROVEMENTS IN AND RELATING TO POLYVINYL CHLORIDE COMPOSITIONS. Solomon Harris Pimser and Robert Roy Smith (to B. X. Plastics Ltd.). British Patent 903,715. Aug. 15, 1962.

A process is given for the manufacture of rigid clear polyvinyl chloride products, e.g., laminated sheets. The process comprises compounding a vinyl chloride polymer or copolymer at ≥50°C with a vinyl ester of a fatty acid, pressing the mixture at 100 to 175°C, and subjecting the pressed mixture to ionizing radiation or heat treatment to polymerize the vinyl ester. (D.L.C.)

27621 VIBRATION COMPACTION. J. J. Hauth (to U. S. Atomic Energy Commission). U. S. Patent 3,042,594. July 3, 1962.

A method of compacting a powder in a metal container is described including the steps of vibrating the container at above and below the resonant frequency and also sweeping the frequency of vibration across the resonant frequency several times thereby following the change in resonant frequency caused by compaction of the powder. (AEC)

Properties and Structure

Refer also to abstracts 26888, 26892, 26893, 26894, 26895, 26896, 28545.

27622 (AD-271176) COMPILATION OF MATERIALS RESEARCH DATA. First Summary Report–Phase II, March 1, 1961 to September 1, 1961. J. E. Chafey (General Dynamics/Astronautics, San Diego, Calif.). Contract AF33(616)-7984. 24p. (AE-62-0060)

Brief descriptions are given concerning progress in materials research. Summaries are included concerning the status and progress on mechanical properties of adhesives at cyrogenic temperatures, high-temperature properties of Nb alloys, properties of selected high-temperature alloys, coatings for refractory metals, crack behavior at cryogenic temperatures, centaur insulation materials, cryogenic properties of nonferrous alloys and stainless steel, austenite decomposition at cryogenic temperatures, and study of fluorocarbon plastics. (J.R.D.)

27623 (ARF-2220-15) DEVELOPMENT OF 2400°F FORGING DIE SYSTEM. Interim Technical Progress Report, March 28, 1962–June 27, 1962. H. Nudelman, A. H. Murphy, T. Watmough, and P. R. Gouwens (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 1962. Contract AF 33(600)-42861. 40p. (ASD-TR-7-886(V))

The upper operating temperature limit of Inconel 713C forging dies was determined by progressively increasing the load and temperature conditions. Ultimate failure occurred by gross cracking at 1900°F under a 1000-ton load while forging steel. During the research to reduce the requisite number of die sequences by an extrusion-forging technique, the die was destroyed. The die design was modified and rebuilding is under way. Prototype construction of a 2400°F system has begun, with the ultimate decision concerning die material still pending. (auth)

27624 (ASD-TDR-62-314) STUDY OF THE MECHANISM OF FAILURE OF ROCKET MATERIALS AND MATERIALS RESEARCH. Y. Baskin, D. C. Schell, and W. K. Sumida (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Jan. 1962. Contract AF33(616)-7048. 108p.

Rocket failure mechanisms in conjunction with the development of nozzle materials for solid propellant motors is discussed. Testing graphite in an oxy-acetylene torch and the effects of purity, density, orientation, and microstructure on erosion-resistance were evaluated. Erosion decreased with greater purity. New graphite materials were developed and evaluated including hot pressed compositions and impregnated bodies. Suitability of ZrC as a

nozzle material was evaluated. Incorporation of Ta and W fibers in ZrC results in considerable improvement in resistance to thermal spalling although not sufficient to prevent cracking. Thoria-base bodies reinforced with W fibers were also studied. Ten promising materials were fabricated into rocket nozzles and tested in static motor stands. Erosion performance is presented along with analysis of failure mechanisms. (auth)

27625 (BM-IC-8082) RARE-EARTH COMPOUNDS AS HIGH-TEMPERATURE REFRACTORIES. A Bibliography. Sara Jane Boles (Bureau of Mines, College Park Metallurgy Research Center, Md.). June 1961. 73p.

References (216) are given to journals, reports, and patents published from 1949 to 1960. The elements included are: Ce, Dy, Er, Eu, Gd, Ho, La, Lu, Nd, Pr, Sm, Tb, Th, Tm, U, and Yb. A subject index is also given. (P.C.H.)

27626 (NAA-SR-6504) THERMAL STRESS TESTING OF BERYLLIUM OXIDE MODERATOR SHAPES. H. L. Sujata, M. King, and F. J. Waters (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 1, 1962. Contract AT(11-1)-Gen-8. 84p.

Perforated BeO plates were thermal shock tested to evaluate the effect of: localized temperature variations adjacent to the perforations, and radial gradients across the entire plate. For localized temperature variations, the plates were subjected to a 1350°F thermal shock from 2400°F; the radial gradient effects were evaluated by an air quench from 1900°F. Measured temperatures were in good agreement with theoretical values. Thermal stress level and distribution were evaluated and compared with measured modulus of rupture values to interpret the degree of cracking and crazing, and the agreement was good. Several plates were cycled with radial temperature gradients, and the development and propagation of cracks was noted. Evidence is presented which shows that BeO plates, subjected to high thermal stresses, crack and craze but still remain functionally useful. (auth)

27627 (NMI-9243) REFRACTORY METALS PHASE DIAGRAMS. Quarterly Progress Report to Aeronautical Systems Division for the Period April 1, 1962–July 1, 1962. E. J. Rapperport (Nuclear Metals, Inc., Concord, Mass.). Aug. 2, 1962. Contract AF33(616)-7157. 17p.

Results on phase studies of binary and ternary alloys are given. The alloys include: Mo–Ti–Zr, Ta–W–Zr, Ta–Zr, Mo–Ir, Nb–Ru, Pd–W, Nb–Rh, Hf–Nb, and Mo–Os–W. Discussion is also given on the preparation of several of the alloys. (P.C.H.)

27628 (NMI-9519) BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report to Aeronautical Systems Division for the Period January 1, 1962–March 31, 1962. S. H. Gelles (Nuclear Metals, Inc., Concord, Mass.). June 25, 1962. Contract AF33(616)-7065. 37p.

Progress on the beryllium research program is reported. Brittle behavior, metallurgical factors affecting ductile-brittle transition, preparation of ultra-fine powder, preparation and evaluation of fine-grained, recrystallization and grain growth, identification of impurities, preparation of high-purity metal, and fabrication from ultra-fine powders is being studied. (M.C.G.)

27629 (NP-11969) ENGINEERING PROPERTIES OF POTASSIUM. Seventh Quarterly Report, April 1–June 30, 1962. Alexis W. Lemmon, Jr. (Battelle Memorial Inst., Columbus, Ohio). June 30, 1962. Contract NAS 5-584. 19p.

Results of measurements on viscosity, vapor pressure, and specific heat of liquid potassium are given. Vapor pressure data on potassium were obtained in stainless steel and in Nb–1 Zr boiling point tubes. Some difference in the behavior of the two tubes was noted, but data from both sources correlate well. Vapor pressures range from 0.0236 atm at 757.7°K to 15.27 atm at 1430.5°K. Brief discussions are given on equipment for measuring specific heat and P-V-T properties of potassium. (P.C.H.)

27630 (NUMEC-P-42) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Monthly Progress Letter for Month of May 1962. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). June 5, 1962. Contract AT(30-1)-2389. 5p.

The effect of plutonium dioxide-uranium dioxide feed material characteristics on sinterability is determined. For this purpose, two continuous coprecipitation runs were completed. Sintering trials verify previously obtained results that high sintered densities cannot be achieved when the oxygen to uranium ratio is greater than 2.3. Studies were continued to assess mechanical sphere forming methods to provide appropriate feed for plasma fusion, swaging, and/or dispersion fuel element rolling. For the plutonium dioxide spheroidizing studies, trials were made employing a blend of plutonium dioxide powders prepared by oxalate precipitation from dilute plutonium nitrate solutions. The results showed that powder pretreated by wet ball milling yielded a better product than powder pretreated by agitation in a low-power ultrasonic field. Characterization of uranium dioxide powder prepared by peroxide and urea precipitation methods was continued to allow product evaluation prior to initiation of studies with plutonium dioxide. Results show that some of the smaller particles coalesced into larger aggregates during sintering. To allow direct chemical preparation of such feed materials, a glove box was outfitted and is now undergoing final leak testing. Peroxide and urea precipitations with plutonium will be made in this box utilizing as a basis the studies being made with uranium as a stand-in material. (N.W.R.)

27631 (NYO-9431) DIFFUSION OF IRON, COBALT AND NICKEL IN GOLD. Report No. 5. David N. Duhl, Ken-ichi Hirano, and Morris Cohen (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). June 6, 1962. Contract AT(30-1)-1975. 20p.

The diffusivities of Fe, Co, and Al in otherwise pure Au were determined by a residual activity technique. It was found that the frequency factors and activation energies of the transition elements into Au are normal relative to the values for Au self-diffusion, and suggest that lattice diffusion is operative, in contrast to the corresponding situation for the diffusion of these elements in Al. This difference in behavior is explained in terms of the marked difference in solid solubilities in the two series. (J.R.D.)

27632 (TRG-Report-108) ZIRCONIUM DATA MANUAL— PROPERTIES OF INTEREST IN REACTOR DESIGN. B. J. Seddon, comp. (United Kingdom Atomic Energy Authority, Reactor Group, Risley, Lancs, England). Sept. 19, 1961. 85p.

A compilation of data on the physical, mechanical, chemical, and irradiation properties of zirconium and certain of its alloys, particularly Zircaloy-2, is presented. A list of the references cited is appended. (M.C.G.)

27633 (UNC-1003) CHARACTERIZATION OF UO_2 POWDERS. Sixth Quarterly Report, January 10, 1962–April 10, 1962. James F. Carpenter, Carl W. Kuhlman, and Robert A. Nelson (United Nuclear Corp. Chemicals Div., Hematite, Mo.). Contract AT(40-1)-2699. 15p.

The chemical and physical characteristics of eleven B-series uranium dioxide powders having a relatively

narrow range of sinterability are related. A correlation was shown to exist between the particle size distribution of pressed powders and the sintered density of hi-fired pellets. Pressed and repulped powders from the twelve oxides originally prepared were used to compare surface area, oxygen to uranium ratio, and sinterability. For powders stored under the same conditions, the oxygen to uranium ratio is directly related to the surface area, and these two factors do not show up as independent effects on the ceramic performance. However, the uranium dioxide powders can be roasted to higher oxygen to uranium ratios without significant changes in surface area of particle size distribution. In this manner, it was found that sinterability, in a cracked ammonia atmosphere, does not change significantly with increased oxygen to uranium ratio. The B.E.T. surface area of the uranium dioxide powders were shown to correlate with sinterability in the early stages of densification. The final sintered densities of pellets obtained after long firing times at high temperatures did not show a good relationship with the powder surface area. (auth)

27634 (WADC-TR-58-360(Pt.IV)) INVESTIGATION OF ELASTIC AND THERMAL PROPERTIES OF CARBON-BASE-BODIES. S. Mrozowski, J. F. Andrew, N. Jull, H. E. Strauss, T. Tsuzuku, and D. C. Wobschall (Buffalo. Univ. Carbon Research Lab.). June 1962. Contract AF 33(616)-7791. 53p.

Families of curves of the dependence of Young's modulus on temperature and on heat treatment were obtained for four basic types of carbons, using high temperature equipment. The decisive influence of filler type was established. As a result of gained experience, improvements in the associated electronics were introduced. The amplitude dependence of the internal friction and dynamic Young's modulus were, for the first time, investigated at room temperature for vibrations in the sonic range of frequencies for several types of carbons. Reproducibility was achieved in measurements of thermal conductivity with the new high temperature test apparatus and families of curves of the dependence of the conductivity on temperature and on heat treatment obtained for soft carbon. A new technique of determining the heat conductivity of carbons without internal heat generation was tried and found to work up to 1800°C. Improved results were obtained with the transient state technique of determination of the heat diffusivity by using a new fast responding pyrometer and a new improved apparatus for the steady sinusoidal wave technique constructed. (auth)

27635 (AEC-tr-5184) THERMODYNAMICS OF PHASE TRANSFORMATIONS IN BINARY ALLOYS. I. L. Aptekar' and D. S. Kamenetskaya. Translated from Doklady Akad. Nauk S.S.S.R., 143: 636-9(1962). 6p.

Developments concerning binary alloy technology are presented. It is noted that phase transformations in binary alloys differ from those in single-component systems in that they are the result of an increase of new phase volume and the redistribution of the components between the contiguous phases. Derivations and other information concerning free energy changes and thermodynamic data are presented in a detailed discussion. (J.R.D.)

27636 (AEC-tr-5256) THE DIFFUSION OF UNIFORMLY DISTRIBUTED RARE GASES FROM SOLID BODIES. H. Matzke and R. Lindner (Linder). Translated by John C. Clayton (Westinghouse Electric Corp., Bettis Atomic Power Lab., Pittsburgh) from Z. Naturforsch., 16a: 845-9(Sept. 1961). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 6757.

27637 (AEC-tr-5301) EXPERIMENTAL STUDY OF THE RECRYSTALLIZATION OF BELGIAN URANIUM. H. Massaux. Translated from J. Nuclear Materials, 5: 287-300(Apr. 1962). 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 18060.

27638 (AEC-tr-5313) ON THE PROPERTIES OF RARE EARTH METALS. Pierre-Gilles de Gennes. Translated by F. A. Smidt and L. A. Smidt (Ames Lab., Ames, Iowa) from Compt. rend., 247: 1836-8(Nov. 24, 1958). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 13, abstract no. 5711.

27639 (AERE-Trans-889) THE MIGRATION OF SOLID METAL SOLUTION COMPONENTS IN A CONSTANT ELECTRIC FIELD. [PARTS] I, II AND III. I. N. (M.) Frantsevich (Frantsevych), D. F. Kalinovich (Kalynovych), I. I. Kovens'kii (Kovens'kyi), and V. V. Pen'kovs'kii (Pen'kovs'kyi). Translated by F. Lachmann from Ukrain. Fiz. Zhur., 3: No. 1, 124-34; No. 1, Suppl., 64-7; No. 4, 552-9(1958). 36p.

The migration of solid metal solution components when under the influence of a constant electric field results from the properties of the metallic state of matter. This state is characterized by the presence of ions and conduction electrons in the lattice of the alloy. In an alloy under the influence of a constant electric field there takes place, besides the directed movement of the conduction electrons, also the directed displacement of ions, which results in a mass transfer. An investigation is made of the electric transfers in the following systems by artificial radioactive isotopes: iron–carbon (using iron-59 and carbon-14), iron–chromium (using iron-59 and chromium-51), iron–molybdenum (using iron-59 and molybdenum-99), and iron–tungsten (using iron-59 and tungsten-185). Results show that the donor-acceptor interaction is based on the action of the transition elements. This interaction results in a strengthened interatomic bonding in the crystal lattice of the solid solution, which is the basic factor as far as heat resistance properties are concerned. (N.W.R.)

27640 (FTD-TT-62-430) ALLOYS BASED ON HIGH-MELTING COMPOUNDS. G. V. Samsonov and K. I. Portnoy. Translation of "Splavy na Osnove Tugoplavkikh Soedineniy" (a publication of State Scientific-Technical Publishing House of Defense Literature, Moscow, 1961). 387p.

Means of identifying alloys based on high-melting compounds, their physicomechanical and mechanical properties, and techniques for producing them are presented. Brief descriptions are given of binary and ternary systems formed between high melting metals (Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Th, and U) and boron, carbon, nitrogen, and silicon, reciprocal alloys of borides, carbides, nitrides, and silicides, and alloys based on nonmetallic high-melting compounds. Examples of industrial applications of the alloys are also given. Coatings formed by high-melting compounds are also described. 316 references are given. (P.C.H.)

27641 (FTD-TT-62-503) STATE OF DEVELOPMENT IN THE FIELD OF HIGH TEMPERATURE MATERIALS. G. Rassmann and A. Merz. Translated from Technik (Berlin), 17: No. 1, 17-23 and No. 2, 74-9(1962). 46p.

Considerations involved in the development of high-temperature stable materials are discussed. A survey is given on composition, properties, and structure of important high-temperature materials. The materials include: steels

and iron base alloys, Ni and Cr base alloys, high melting metals and their alloys, carbides, borides, nitrides, silicides, intermetallic compounds, and oxide cermets. (P.C.H.)

27642 (FTD-TT-62-505) HIGHLY REFRACTORY SYSTEMS WITH LANTHANIDE AND ACTINIDE OXIDES. S. G. Tresvyatskii (Tresvyatskiy) and A. M. Cherepanov. Translated from Zhur. Vsesoyuz. Khim. Obshchestva im. D. I. Mendeleeva, No. 6, 612-18(1961). 16p.

Phase studies were made of highly refractory oxides with oxides of lanthanides and actinides. Since methods of investigating phase diagrams of highly refractory oxides are still not perfectly complete, a part of the diagrams are considered as orientation diagrams. Generalizations are made about the systems. (N.W.R.)

27643 THE STUDY OF CHEMICAL BONDS BY NUCLEAR QUADRUPOLE EFFECTS. P. J. Bray (Brown Univ., Providence). Acad. roy. Belg. classe Sci. Mem. Collection in 8°, 33: 289-320(1961). (In English)

The theory of nuclear magnetic resonance with quadrupole effects is described with B^{11} as an example. Experimental results are surveyed in detail for the following compounds: B_4C, BPO_4, ZrB_2, TiB_2, BN, and glasses containing B_2O_3 (Li^7 was used here as well as B^{11}). (D.L.C.)

27644 THE UNIT CELL AND SPACE GROUP OF $2Y_2O_3.Al_2O_3$. John W. Reed and A. B. Chase (Hughes Research Labs., Malibu, Calif.). Acta Cryst., 15: 812 (Aug. 10, 1962).

Crystallographic studies were made on $2Y_2O_3 \cdot Al_2O_3$ crystals. Single crystals of a size suitable for x-ray diffraction were grown by the flame fusion method. The structure was found to be monoclinic from Weissenberg and precession photographs. Two systematic extinctions were observed, (OkO) with k odd and (hOl) with l odd, so that the space group is determined uniquely as $P2_1/c$. The lattice constants were determined from rotation photographs of the (hOl) and (Okl) zones. The dimensions of the monoclinic cell are a = 7.373, b = 10.467, c = 11.121 A, and β = 108.53°. (M.C.G.)

27645 OBSERVATION OF DISLOCATION MOVEMENT AND INTERACTION IN ZIRCONIUM BY TRANSMISSION ELECTRON MICROSCOPY. L. M. Howe (Atomic Energy of Canada Ltd., Chalk River, Ont.), J. L. Whitton, and J. F. McGurn. Acta Met., 10: 773-87(Sept. 1962).

Observations on annealed zirconium foils by transmission electron microscopy reveal that dislocations can be induced to move in zirconium by increasing the intensity of illumination above that normally used in the microscope. The moving dislocations leave behind pronounced dislocation traces and interactions between the dislocation traces were observed in a large number of cases. Dislocation movement occurred on many different planes but in the majority of cases it occurred on the prismatic planes. In some foils, segments of dislocations, which were effectively pinned at their ends at dislocation nodes, expanded outwards about these pinning points and in several instances dislocation loops were also produced. (auth)

27646 TEXTURE OF AUSTENITIC STAINLESS STEELS COLD-WORKED AT LOW TEMPERATURE. Daniel Mugnier and Jean Geneste (Université, Grenoble, France). Compt. rend., 254: 2976-7(Apr. 16, 1962). (In French)

The structure changes in an austenitic stainless steel (Cr 17.6%, Ni 9.8%, and C 0.03%) which was hyper-tempered from 1150°C and then cold-worked in liquid nitrogen under stresses varying from 0 to 170 kg/mm^2 were studied by x-ray and electron diffraction and by an electron microscope. The results show that a compact hexagonal phase appears at the same time as the final martensitic cold-working phase. The evolution processes for the $\gamma \rightarrow \alpha$ transformation are defined. The high stresses used permitted observation of particularly large and well developed "needles" on which it was possible to obtain microdiffraction diagrams of compact hexagonal homogeneous monocrystals. (J.S.R.)

27647 THERMAL EVOLUTION OF UO_3 UNDER VACUUM. ELECTRIC CONDUCTIVITY. Michel Murat and Charles Eyraud (Laboratoire de Génie Chimique, Faculté des Sciences, Lyon). Compt. rend., 254: 3084-6(Apr. 25, 1962). (In French)

The intermediate uranium oxides obtained during the decomposition of UO_3 under vacuum between 25 and 650°C show variations of electric conductivity which permit the determination of the energy of formation of oxygen vacancies. (tr-auth)

27648 THE OXIDATION OF ZIRCONIUM. Jean Debuigne and Pierre Lehr. Compt. rend., 254: 3710-12 (May 21, 1962). (In French)

Oxidation tests were made at atmospheric pressure between 600 and 850°C under dried oxygen on samples of Kroll zirconium chemically polished. The oxidation phenomenon obeys a single kinetic of the form $m^n = Kt$, where m is the gain in mass in mg per cm^2 and t is the time in hours. The exponent n has the mean value 2.3, close to the value 2 corresponding to a parabolic law. The constant K obeys the Arrhenius law, and an activation energy of the order of 30 kcal per mole was determined. Typical transmission micrographs of oxide films are shown. The x-ray diffraction patterns show that at the beginning of the oxidation the oxide layer is constituted essentially of monoclinic zirconium. (J.S.R.)

27649 SYSTEMS FORMED BY LANTHANUM SULFIDE La_2S_3 WITH THE SULFIDES MS OF DIVALENT METALS. Jean Flahaut, Louis Domange, and Madeleine Patrie. Compt. rend., 254: 4037-9(June 4, 1962). (In French)

A study is made of the systems formed by La_2S_3 with the sulfides of Ca, Sr, Ba, Pb, Mn, Cr, Fe, and Mg. The systems formed with Ca, Sr, Ba, and Pb are characterized by the existence of compounds with the general formula MLa_2S_4 and by the presence of a solid solution between these compounds and the lanthanum sulfide. The compounds are cubic of the Th_3P_4 type. The systems formed with Mn, Cr, and Fe form an extremely homogeneous group characterized by the existence of the compounds MLa_2S_4, all with the same crystalline type which was, however, unidentified. No definite compound could be isolated after heating to 1400°C a mixture in various proportions of La_2S_3 and MgS, but a solid solution of very limited extent was observed in the immediate vicinity of $La_2S_3\gamma$. (J.S.R.)

27650 THE DISSOLUTION OF OXYGEN IN THE METALLIC LATTICE DURING THE OXIDATION OF ZIRCONIUM AT HIGH TEMPERATURES. Jean Debuigne and Pierre Lehr. Compt. rend., 254: 4168-70(June 13, 1962). (In French)

It is shown that during the oxidation of pure zirconium at high temperatures (600 to 850°C) under pure oxygen, there is superposed on the growth of a film of monoclinic zirconium oxide a very sharp diffusion of oxygen into the underlying metal. One of the principal consequences of this diffusion is the fragilization of the metal. (J.S.R.)

27651 EVIDENCE OF LONG RECTILINEAR DISLOCATION IN WEAKLY WORKED ALUMINUM–ZINC ALLOYS. Pierre Lesbats (Centre National de la Recherche Scientifique, Paris). Compt. rend., 255: 113-15(July 2, 1962). (In French)

Electron microscopic studies were made of the structure of Al-Zn alloys containing 10 wt.% Zn, slightly rolled, and the structures found were compared with those of unalloyed Al worked under the same conditions. In the Al-Zn alloy, rectilinear and parallel dislocations were detected. The orientation of these dislocations suggests that they can act as Lomer-Cottrell barriers. These dislocations persist after careful thermal treatments. (J.S.R.)

27652 AN INVESTIGATION OF THE STRUCTURE OF ALLOYS IN THE NICKEL–CHROMIUM–BORON SYSTEM. P. T. Kolomytsev (N. E. Zhukovskii Engineering Air Academy, USSR). Doklady Akad. Nauk S.S.S.R., 144: 112-4(May 1, 1962). (In Russian)

Carbonyl nickel (99.98%), purified chromium (99.94%), and amorphous boron were fused in a pure argon atmosphere, and were annealed at 1000°C for 250 hours. X-ray powder analysis was used to determine the phase composition of the alloy. The solubility of boron in the nickel-chromium solid solution is 0.02 to 0.04 at.%. At high boron concentrations in the alloy, nickel does not dissolve in the chromium boride, and chromium does not dissolve in the nickel boride Ni_3B. Three structural constituents were detected by hardness measurements: a γ solid solution of nickel with the smallest microhardness, an ϵ-phase of CrB with the highest microhardness of 1700 kg/mm^2, and a β-phase of the nickel boride Ni_3B. The introduction of a small amount of titanium or aluminum into a nickel-chromium alloy containing boron does not lead to the formation of new boride compounds, but does affect the structure of the boride compound formed in the alloy. Thus, the ϵ-phase (CrB) is formed in a nickel-chromium alloy containing 2.59 wt % Ti and 0.86 wt % Al, the δ-phase (Cr_5B_3) is formed in an alloy containing 3% Ti and 1.75% Al, and the β-phase is formed in an alloy containing 2.70% Ti and 1.0% Al. The structure of the boride phase depends on the content of aluminum in the alloy. (TTT)

27653 AN INVESTIGATION OF HIGH-PURITY METALLIC SCANDIUM. A. A. Men'kov, L. N. Komissarova, V. V. Karelin, Yu. A. Priselkov, An. N. Nesmeyanov, and Vikt. I. Spitsyn (Moscow Univ., USSR). Doklady Akad. Nauk S.S.S.R., 144: 122-5(May 1, 1962). (In Russian)

Scandium metal was prepared by reducing ScF_3 or anhydrous $ScCl_3$ with calcium metal in an argon or helium atmosphere at 850 to 900°C. The metallic scandium contained 2.5% Sc_2O_3 as the principal impurity. The metal was further purified by distilling from a tantalum crucible in a high vacuum (10^{-5} to 10^{-6} mm Hg std) at 1500 to 1650°C. The resulting product of metallic scandium contained 99.5 wt % Sc and <0.1% oxygen. Experiments with the metal showed an increase of 0.4% for a 20 hour exposure of the metal to dry oxygen at 200°C. The increase in weight was 1.0% in moist oxygen at 200°C, 2.0% in dry oxygen at 250°C, and 2.5% in moist oxygen at 250°C. Sc metal started to react with N_2 at 600°C, and the reaction proceeded at a significant rate at 800°C. The formation of ScN was 65% complete at 800°C after 20 hours. Sc metal dissolved 50 times faster in weak HCl or H_2SO_4 than in HNO_3 solutions. Sc metal scarcely reacted with 10% NaOH, but did dissolve slowly in 20, 30, and 40% NaOH at 25°C. The chemical properties of Sc metal depended very little on its purity. (TTT)

27654 THE DIFFERENTIAL HEATS OF ADSORPTION OF OXYGEN AND OF WATER VAPOR ON A GRAPHITE SURFACE. Yu. A. Zarif'yants, V. F. Kiselev, and G. G. Fedorov (Moscow Univ., USSR). Doklady Akad. Nauk S.S.S.R., 144: 151-4(May 1, 1962). (In Russian)

Highly dispersed, freshly cleaved graphite with a surface area S = 350 m^2/g was prepared by grinding natural graphite in an argon atmosphere. The initial heat of adsorption of oxygen on this graphite was very high (110 kcal/mol). The differential heat of adsorption began to fall at a saturation of 0.5 μM/m^2 of oxygen, and was only about 55 kcal/mol at a saturation of 1.0 μM/m^2 of oxygen. The high initial differential heat may be due to the formation of carbonyl groups or to various oxygenated radicals. The oxidized graphite sample was then exposed to water vapor. The initial differential heat of adsorption was found to be 40 kcal/M, and it is hypothesized that hydroxy groups are formed on the surface of the oxidized graphite. The experimental results can be reproduced on different samples. (TTT)

27655 A MICROAUTORADIOGRAPHIC STUDY OF THE REGULATING ACTION OF OXYGEN ON THE ADSORPTION AND DISTRIBUTION OF SODIUM TRIDECYLATE (TAGGED WITH C^{14}) ON A NUMBER OF RARE EARTH MINERALS. L. N. Plaksin and S. P. Zaitseva (A. A. Skochinskii Mining Inst., USSR). Doklady Akad. Nauk S.S.S.R., 144: 857-60(June 1, 1962). (In Russian)

A 0.2 gram sample of bastnesite or monazite having a particle size of 0.044 to 0.074 mm was treated with sodium tridecylate as a collector at reagent dosages of 150 to 1000 grams/metric ton. Since the collector was tagged with C^{14}, the surface coverage of the particles and the evenness of distribution of the collector in the particle could be followed by taking autoradiographs of individual particles at various doses of the collector. The percentage of particles not covered by reagent decreased to 18 to 20% at a dose rate of 500 g/metric ton, and fell only to 11 to 14% when the dose rate was increased to 750 g/metric ton. On increasing the content of oxygen in the pulp from 8 to 36 mg/liter, the absorption of tridecylate on a bastnesite particle increased significantly at low dose rates (up to 500 g/metric ton), and the evenness of distribution was increased with an increase in the oxygen content of the pulp, even at high dose rates of the collector. (TTT)

27656 SOME ELEMENTARY THEORETICAL CONSIDERATIONS CONCERNING SUPERCONDUCTIVITY OF SUPERIMPOSED METALLIC FILMS. L. N. Cooper (Brown Univ., Providence). IBM J. research develop., 6: 75-6 (Jan. 1962).

A microscopic theory of superconductivity of superimposed metallic films is proposed, based on the fact that the electron pair correlation function penetrates into a normal metal where the electron-electron interaction would not by itself produce a superconducting state. (auth)

27657 THE DETERMINATION OF SELF-DIFFUSION COEFFICIENTS OF MOLTEN METALS BY MEASUREMENT OF THE RADIOACTIVITY DURING THE DIFFUSION PROCESSES. W. Lange, W. Pippel, and H. Oppermann (Technische Universität, Dresden). Isotopentechnik, 2: 132-4(May 1962). (In German)

An apparatus was developed which permits the concentration of a radioactive component to be followed during the diffusion process as a function of time by measurement of the γ radiation beam scattered at a fixed point of the sample. By maintenance of the boundary conditions applied in monitoring methods, the self-diffusion coefficient of tin could be determined above the melting point in dependence on the temperature by using radiochemically purified $Sn^{113/121}$. Comparison with measurements which were carried out by other methods shows that the apparatus described for the measurement of self-diffusion coefficients by the use of γ-emitting isotopes is suitable for liquid metals. (tr-auth)

27658 ON REDISTRIBUTION OF CARBON AND TUNGSTEN IN Nb DURING ZONAL RECRYSTALLIZATION. A. I. Evstyukhin, V. V. Nikishanov, and I. V. Milov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 3, 98-101(May-June 1962). (In Russian)

Separation of technically pure Nb from C and W by zonal recrystallization in an electric arc furnace was analyzed using C^{14} and W^{182} tracers. The microhardness and radioactivity along Nb specimens after 10 recrystallizations diminish from the top to the bottom. The tests proved the feasibility of zonal recrystallization in arc furnaces as an effective separation method. (R.V.J.)

27659 ROENTGENOGRAPHIC STUDIES OF PSEUDOTERNARY WC–TiC–TaC AND PSEUDOQUATERNARY WC–TiC–TaC–NbC SYSTEMS. N. A. Vatolin and R. Kisling. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 3, 102-6(May-June 1962). (In Russian)

The solubility limits of WC at 1420 to 1600°C in pseudoternary TiC–TaC–WC and the cross section of pseudoquaternary TiC–TaC–WC–NbC (20% NbC) were studied. Additions of 20% NbC to TiC–TaC–WC shift the solubility limits of WC towards increased content at 1420 and 1600°C. (R.V.J.)

27660 EFFECTS OF CERIUM ON VANADIUM PLASTICITY. E. M. Savitskii, V. V. Baron, and Yu. V. Efimov. Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk, Met. i Toplivo, No. 3, 107-13(May-June 1962). (In Russian)

Admixtures of Ce to V purify the metal and reduce the nitrogen and oxygen to a level that does not effect plasticity. The content of carbon and metallic admixtures are not affected. A considerable desulfurization is also achieved by Ce refining. Cerium refined V renders to cold rolling, without intermittent annealing, to 95% deformation. (R.V.J.)

27661 COMPARISON OF TENSILE PROPERTIES OF ZONE-REFINED NIOBIUM ROD AND SHEET. J. D. W. Rawson and W. J. McG. Tegart (Univ. of Sheffield, Eng.). J. Inst. Metals, 90: 448(July 1962).

Experiments were carried out to examine the effect of specimen preparation and geometry on the tensile properties of zone-refined Nb. A 0.3-in. dia Nb bar was zone-refined in 8 passes, swaged, and recrystallized at 1200°C, and part of the bar was swaged to 0.1-in. dia rods, while the rest was rolled to 0.021-in. thick sheets, both reductions being equal in area. The rods and sheets were then vacuum annealed at 1125°C; the resulting structures had small surface grains with very coarse grains in the interior. Stress/elongation tests show different lower yield stresses for rod and sheet (8,600 and 11,700 lb/in.^{2}, respectively) but similar ultimate tensile stresses (20,900 and 20,800 lb/in.^{2}). (D.L.C.)

27662 NUCLEAR SPIN-LATTICE RELAXATION IN Nb METAL. Kunisuke Asayama and Junkichi Itoh (Osaka Univ.). J. Phys. Soc. Japan, 17: 1065(June 1962). (In English)

Nuclear spin-lattice relaxation times in Nb, Pb, and Sn were measured at 2 to 77°K at 14 Mc by the pulse technique. All samples were powders of 1 to 10 μ in size; the purities of the Pb and the Sn were 99.9%, and that of the Nb was 99.5%. Knight shifts, calculations, and data are presented in tabular form. (L.N.N.)

27663 NEW PYROLYTIC MATERIALS. R. G. Bourdeau (High Temperature Materials, Inc., Brighton, Mass.). Materials in Design Eng., 56: 106-9(Aug. 1962).

Advantages of materials produced by pyrolytic deposition are discussed. Materials, shapes, and structures are discussed. Properties of anisotropic and isotropic materials are described. (M.C.G.)

27664 CONTRIBUTION TO THE STUDY OF THE MECHANISM FOR THE PRODUCTION OF ROLL AND EXTRUSION TEXTURES IN BERYLLIUM. P. Pointu, P. Azou and P. Bastien. Mém. sci. rev. mét., 59: 321-42(May 1962). (In French)

The simultaneous study of the plastic deformation in the polycrystalline metal and in single crystals, for different initial preferred orientations and at different temperatures, shows the deformation mechanisms which are involved in the successive stages of a texture development. (tr-auth)

27665 THERMAL TREATMENT OF STAINLESS STEELS NEAR THE SOLIDUS. THE CASE OF 18-8 Ti AUSTENITIC STEEL. MODIFICATIONS IN STRUCTURE AND IN RESISTANCE TO CORROSION BY BOILING NITRIC ACID. R. Castro, P. Dévoré, and R. Devin. Mém. sci. rev. mét., 59: 343-56(May 1962). (In French)

It is shown that super-quenching from very high temperatures, below and above the solidus, produces marked structural changes in type 18-8 Ti stainless steel. These changes are characterized by the appearance of a dendritic precipitate at the grain boundaries. This precipitate, which is identified as titanium carbide of nonstoichiometric composition, dissolves when the super-quenched metal is exposed to concentrated boiling nitric acid. This explains the process of penetrating (or knife-edge) corrosion which affects welded austenitic stainless steels in nitric environment. (tr-auth)

27666 STRUCTURE OF ZIRCONIUM ALLOYS. G. Duret. Mém. sci. rev. mét., 59: 357-63(May 1962). (In French)

The structure of Zr alloys was studied using the Schulz method. Films obtained by transmission photography complement the results. The basic and pyramidal planes of the hexagonal structure were examined. Zircaloy-2 products in the form of extruded or drawn tubes have textures in which the (0001) base planes are parallel to the tube axis. The (1011) pyramidal planes are situated near the tangential plane. Drawn tubes have a less pronounced texture than the extruded ones. Annealing sharpens the structure described. The texture of plates or sheets is the same as the recrystallization texture whatever the last transformation stage, whether hot or cold rolling. The (0001) base planes and (1011) pyramidal plane are almost parallel to the rolling direction. The rate of cold rolling must be very high in order to recover the rolling texture. Forged and cold-rolled samples of Zr–U alloys have the same texture as cold-rolled Zr. Annealed samples keep the same recrystallization texture even after further cold rolling. (tr-auth)

27667 CONTRIBUTION TO VACANCIES TO THE PORTEVIN-LE CHATELIER EFFECT IN Al-Mg ALLOYS. J. Caisso and J. Guillot. Mém. sci. rev. mét., 59: 395-403 (May 1962). (In French)

Tensile tests were made on Al-Mg alloys in order to determine in the region ($V = d\epsilon/dt$, T) the characteristic quantities ϵ_m (extension at the occurrence of sharp bends) and R (rupture charge). It was found that there are two regions corresponding to $d\epsilon_m/dt < 0$ (I) and to $d\epsilon_m/dT > 0$ (II) separated by a narrow temperature region (approximately 15°) where ϵ_m remains almost constant around its minimum and is independent of the velocity V. The inverse role played by the parameters V and T was detected. The II region which occurs above room temperature was especially studied for the velocity range $10^{-4}/S < V < 2 \times 10^{-2}/S$. The expression derived from the Cottrell theory $V = A/T\, e^{-Q/RT}$

represents the activation energy of the vacancy. In order to take into consideration the time required for the metal to reach the work-hardened condition necessary for the Portevin-Le Chatelier phenomenon, the time t_m which measures the duration of the test up to the appearance of sharp bends was taken as a parameter. The empirical law $t_m = AV^{-n}e^{-Q/RT}$ was derived where n is close to $\frac{3}{4}$ and seems to be only slightly affected by the Mg concentration, whereas Q has a value varying only slightly from 11,000 cal/mol. It is noticed that this last value corresponds to that generally used for the displacement energy of isolated vacancies. (tr-auth)

27668 COMBINED CREEP AND FATIGUE PROPERTIES. A. H. Meleka (British Iron and Steel Research Assn., London). Met. Revs., 7: 43-93(1962).

A review is presented on combined creep and fatigue. Some service applications in which combined creep and fatigue stresses exist are described. Testing techniques and methods of presenting results are discussed. The behavior of commercial alloys and basic considerations are discussed. Methods of predicting combined creep and fatigue behavior are discussed, and evidence is given for correlation between separate creep and fatigue properties. Finally, proposals are made for future research. (D.L.C.)

27669 EFFECT OF STRAIN-RATE ON THE TENSILE-YIELD STRESSES OF NIOBIUM AND TANTALUM. G. A. Sargent, P. J. Sherwood, and A. A. Johnson (Imperial Coll. of Science and Tech., London). Nature, 195: 374-5(July 28, 1962).

Measurements are reported on the effect of strain rate on the tensile-yield stresses of commercially pure Nb and Ta. On a yield stress vs log strain rate graph, the results show step-like patterns for both Nb and Ta, there being three linear ranges for Nb and four for Ta. The ranges can be expressed by $\sigma_y = A + A' \log \epsilon$, and an interpretation of A' in terms of the activation enthalpy is given. It is concluded that the mechanism controlling the deformation changes with strain rate in both metals. (D.L.C.)

27670 GAMMA PHASE IN THE ZIRCONIUM–HYDROGEN SYSTEM. Ryukichi Nagasaki and Satoru Kawasaki (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 4: 294-99(May 1962). (In Japanese)

The effects of hydrogen contents and heat treatments on the metastable γ' phase of a zirconium–hydrogen system were studied. Zirconium sheets were reacted with hydrogen gas at 500 and 700°C. After the zirconium sheets absorbed hydrogen, they were cooled slowly and the amount of the γ' phase was measured by x-ray diffraction. Then specimens were reheated to 500 and 700°C and were quenched in water. After these treatments, the amount of the γ' phase was measured again. When specimens are cooled slowly, the γ' phase increases with hydrogen content in the $\alpha + \delta$ region. The γ' phase increases by rapid cooling except in the case that $\beta \rightarrow \alpha'$ transformation occurs and the α' phase remains down to room temperature. The result of high temperature x-ray analysis shows γ' transformation occurs below eutectoid temperature. The result of the metallographic examination could not distinguish the γ' phase from other structures in the zirconium hydride. (auth)

27671 PHASE EQUILIBRIA IN SUPERCONDUCTING NIOBIUM–ZIRCONIUM ALLOYS. C. W. Berghout (Philips Research Lab., Eindhoven, Netherlands). Phys. Letters, 1: 292-5(July 1, 1962). (In English)

The phase diagrams Nb-Zr, Nb-Zr-O, and Nb-Zr-N were examined. Simplicity was obtained in the binary diagram Nb-Zr. The region of two bi-centered cubic phases in the generally-accepted diagram of Nb-Zr is not found in the pure binary alloys, but only in Nb-Zr-O alloys. Former (B. A. Rogers and D. F. Atkins, Trans. A.I.M.E., 203: 1034 (1955)) and revised phase diagrams are presented. (L.N.N.)

27672 EFFECT OF SELF-IRRADIATION ON THE RESISTIVITY OF PLUTONIUM. J. A. Lee (Atomic Energy Research Establishment, Harwell, Berks, Eng.), K. Mendelssohn, and D. A. Wigley. Phys. Letters, 1: 325-7(July 15, 1962). (In English)

Continuous observations were made on α-Pu kept below 20°K for more than 3.5×10^3 hours. The specimen was kept in liquid He (~5°K) for most of the time and was occasionally temporarily transferred into a bath of liquid H (~20°K). Changes in conductivity were plotted in relation to temperature and time, and features aiding in understanding the mechanism of the electric conductivity anomaly were noted. (L.N.N.)

27673 THE BAND STRUCTURE OF HEXAGONAL CLOSE-PACKED METALS: ZIRCONIUM. S. L. Altmann and C. J. Bradley (Dept. of Metallurgy, Oxford). Phys. Letters, 1: 336-7(July 15, 1962). (In English)

The cellular method was used, since the orthogonalized plane-wave method is likely to converge slowly for metals departing significantly from the free-electon model. Previous computations (S. L. Altman, Proc. Roy. Soc. (London) A244, 141: 153(1958)) are extended. The program can deal with all six points of symmetry of the Brillouin zone as well as with any values of the propagation vector $\vec{K}$ along seven lines of symmetry. Considerable detail for the bands is obtained, and interpolation for the energy eigenvalves for a general value of $\vec{K}$ is allowed using a purely geometrical scheme. Densities of states for the metal may be computed by a Monte Carlo method. The programs were run for the free-electron case as an accuracy check; satisfactory accuracy was obtained. Results of 43 eigenvalue computations for the empty lattice are summarized in tabular form. The density of states curve for zirconium is given. (L.N.N.)

27674 COLD NEUTRON MEASUREMENT OF THE PHONON DISPERSION-RELATION FOR A ZINC SINGLE-CRYSTAL. E. Maliszewski (Inst. of Nuclear Research, Warsaw). Phys. Letters, 1: 338-9(July 15, 1962). (In English)

Measurement of the coherent inelastic scattering of cold neutrons from a single crystal gives information on the frequency-wavenumber relation for phonons in crystal lattices. Phonon dispersion relations were measured for zinc, which has a c:a of 1.86. Neutron energy distributions were measured for the angular settings of the crystal, using a chop-per and time-of-flight method. Satisfactory results were obtained and are presented in graphical form. (L.N.N.)

27675 DISLOCATION CONTRIBUTION TO THE ELASTIC CONSTANTS OF BODY-CENTERED CUBIC CRYSTALS. Bal Krishna Agrawal and G. S. Verma (Univ. of Allahabad, India). Phys. Rev., 127: 501-2(July 15, 1962).

Expressions for dislocation contribution to the elastic constants of bcc crystals are obtained and applied to lithium. The contribution comes out to be less than 1% for screw dislocations. For edge dislocations, the contribution is about 1.3%. Edge dislocations are found to make a contribution about seven times larger than that of a similar density of screw dislocations. (auth)

27676 ELECTRICAL, MAGNETIC, AND MECHANICAL STUDIES OF RECOVERY IN NICKEL. H. Kronmueller, A. Seeger, H. Jaeger, and H. Rieger (Max-Planck-Institut

für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). Phys. Status Solidi, 2: K105-11(1962). (In English)

The annealing of magnetic properties such as reversible susceptibility, coercive force, and magnetic aftereffects were studied. Lattice defects were generated by plastic deformation at room temperature, quenching from high temperature to room temperature, and neutron irradiation at room temperature. The annealing processes followed were migration of interstitials, migration of vacancies, and rearrangement and annihilation of dislocations. The results obtained in the study for different treatments and properties are tabulated, and the significant results are discussed. (J.S.R.)

27677 DETERMINATION OF THE ELECTRICAL PROPERTIES OF GRAPHITE AT HIGH TEMPERATURES. L. F. Maltseva and E. N. Marmer. Poroshkovaya Met., No. 1, 50-6(Jan.-Feb. 1962). (In Russian)

A procedure and a set-up are described for the determination of the temperature dependence of the specific conductivity of brand graphites to 2500°C. On the basis of the data, formulas are presented for calculating the specific conductivity at 1000 to 2500°C. (auth)

27678 MECHANICAL PROPERTIES OF THE GRAPHITE USED IN VACUUM ELECTRIC FURNACES. O. S. Gurvich and E. N. Marmer (All-Union Scientific Research Inst. of Electric Equipment, Ukrainian SSR). Poroshkovaya Met., No. 2, 77-86(Mar.-Apr. 1962). (In Russian)

Data are presented on the mechanical, tensile, and creep strengths of graphites in vacuum at temperatures up to 2300°C. The testing procedure and set-up are described. (auth)

27679 CERTAIN DATA ON THE EFFECT OF TEMPERATURE ON THE STRENGTH AND PLASTICITY OF SOME REFRACTORY COMPOUNDS. V. K. Kharchenko and L. I. Struk (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukrainian SSR). Poroshkovaya Met., No. 2, 87-91(Mar.-Apr. 1962). (In Russian)

The bending strength of titanium and molybdenum carbides and zirconium boride in the temperature range of 20–2500°C was studied. Titanium and molybdenum carbides were found to have a maximum strength at 0.6 of the melting point. Of the investigated refractory materials, titanium carbide was found to possess considerable plasticity at temperatures of 2200–2450°C. (auth)

27680 THE TEMPERATURE DEPENDENCE OF CERTAIN MAGNETIC PROPERTIES OF GADOLINIUM. R. V. Telesnin, D. B. Al'meneva, and V. A. Pogozhev (Moscow State Univ.). Soviet Phys.-Solid State, 4: 256-8(Aug. 1962).

Magnetic viscosity, coercive force, magnetic susceptibility, intensity of magnetization, and remanent induction were investigated for a toroidal specimen of metallic gadolinium (purity 99.9%) at 78 to 300°K. The minimum coercive force and the maximum (in fields up to 12 O) intensity of magnetization and remanent induction were observed at 210°K. Magnetic viscosity in gadolinium is slight, and the duration of magnetic reversal processes is principally determined by the retarding effect of eddy currents. (auth)

27681 EFFECT OF THE FIRST-ORDER PHASE TRANSITION IN CERIUM ON THE HALL EFFECT. A. I. Likhter and V. A. Venttsel (Inst. of High-Pressure Physics, Moscow). Soviet Phys.-Solid State, 4: 352-5 (Aug. 1962).

The change in the Hall emf was measured during the transition in cerium at 7600 atm at room temperature. The Hall coefficient is reduced by a factor of 4. Using a two-zone conduction model, it can be shown that this result does not contradict the assumption of transfer under pressure of a $4f$ electron to the 5d band. (auth)

27682 TECHNOLOGY OF SHIELDING CONCRETE FOR HIGH TEMPERATURE REACTORS. F. Bremer. Tech. Mitt. Krupp, 20: 119-24(Apr. 1962). (In German)

A shielding concrete for high temperature reactors contains, at relatively high density, more hydrogen in the form of combined water than the concretes of other reactor types in order to obtain good shielding properties. The hydrogen required is supplied by the water contained in chemically combined form in the cement, by suitable additions to the cement, and by minerals in the aggregate. Research was carried out in this area by Fried Krupp Baubetriebe. (tr-auth)

27683 MATERIALS FOR HIGH AND HIGHEST TEMPERATURES. TRENDS IN THE DEVELOPMENT OF NONFERROUS METALS AND CERMETS. Jiří Chvojka. Tech. práce, No. 11, 945-52(1961).

Mechanical requirements necessary for metals used in the construction of equipment designed to operate at high temperatures, such as thermal machines, aircraft, and rockets, are listed, along with properties of various metals and alloys suitable for this purpose, namely: Al, Mg, Ti, Be, Cu, Co, Ni, V, W, Mo, Nb, Ta, Re, metals of the Pt-group, and metal-ceramic materials (cermets). (OTS)

27684 OXIDATION OF TITANIUM, ZIRCONIUM, MOLYBDENUM AND OF SOME OF THEIR ALLOYS. V. V. Andreeva and E. L. Alekseeva (Inst. of Physical Chemistry, Academy of Sciences, USSR). Zhur. Priklad. Khim., 35: 1175-83(June 1962). (In Russian)

Although the corrosive behavior of Ti, Zr, and Mo has been studied exhaustively, only insufficient information is available at the lower temperature range. Therefore, the interaction of O_2 and air with these metals and with Ti alloys containing 10% Mo and 5% Cr +3% Al was investigated within the temperature range of 20 to 400°C. An optical polarization method involving the measurement of the thickness of the thin film formed on the surface of the metals by determining the change of the ellipticity of the reflected light was used for the measurements. From the kinetics of the film growth thus obtained it was established that in the temperature range above 200°C the Zr possesses the highest oxidation rate as a result of the increase of the monoclinic modification of ZrO_2. At temperature above 300°C Mo also presents a high oxidation rate but the Ti alloy containing 10% Mo had a lower rate at the same temperature than pure Ti; this might be due to differences in the structural defects in the oxide films. It was found to be lower in wet air than in dry air. At the lower temperatures the growth rate of the film follows the logarithmic law; at higher temperatures a parabolic correlation is noticed indicating that the growth is due to diffusion phenomena. (TTT)

27685 THE INFLUENCE OF PRESSURE ON DIFFUSIONS LEADING TO INTERMETALLIC COMPOUNDS. Y. Adda, M. Beyeler, A. Kirianenko, and B. Pernot (Centre d'Études Nucléaires, Saclay, France). p.512-24 of "Proceedings of the Fourth International Symposium on the Reactivity of Solids." Amsterdam, Elsevier Publishing Company, 1960. (CEA-1664). (In French)

Some investigators, A. D. Le Claire, J. L. Zambrow, and L. Castleman, have shown that application of uniaxial pressure parallel to the direction of diffusion may notably

modify the kinetics of growth of the intermediate phases which can be formed in this direction. The interpretation of this phenomenon being obscure, an attempt is made to explain it by detailed analysis of the experimental facts. The microscopic studies of the kinetics of growth of the zones formed shows, particularly in the couples uranium-copper and uranium-nickel, that it is influenced in a similar manner by a uniaxial pressure and a hydrostatic one. On the other hand, the rate of growth of these zones increases as a function of the applied pressure in the systems uranium–copper, uranium–nickel and uranium–aluminum (this effect being particularly marked in uranium–aluminum). To determine with precision the limits of the range of stability of the intermetallic compounds, the curves of concentration penetration characteristics of the diffusion were established by means of the Castaing electronic microanalyzer. The examination of the results indicates that: when diffusion takes place without external pressure (couples UCu and UNi) or with a pressure less than 300 kg/cm^2 (couple UAl), the concentration varies notably in the compounds obtained, which theoretically are stoichiometric. Thus, when crossing the zone of diffusion of one base metal to another one notes a continual passage of: $UCu_{4.79}$ to $UCu_{5.25}$ in the couple U-Cu; $UNi_{4.75}$ to $UNi_{5.25}$ in the couple U-Ni; $UAl_{2.2}$ to $UAl_{3.3}$ in the couple U-Al. If a uniaxial or hydrostatic pressure above 500 kg/cm^2 is applied to the couples U-Cu and U-Ni, or above 1000 kg/cm^2 for the couples U-Cu and U-Ni, or above 1000 kg/cm^2 for the couple U-Al, the composition is then constant in the zones formed. It corresponds to: UCu_5 in the couple U-Cu; UNi_5 in the couple U-Ni; UAl_3 in the couple U-Al. The results are confirmed by an x-ray-diffraction study, mainly in the U-Cu system. Experiments in progress seem to show that deviation from stoichiometry cannot be observed in alloys prepared by the classical techniques of fusion. (auth)

27686 DIFFUSION KINETICS IN URANIUM DIOXIDE. J. Belle, A. B. Auskern, W. A. Bostrom, and F. S. Susko (Westinghouse Electric Corp., Pittsburgh). p.452-66 of "Reactivity of Solids." Proceedings of the Fourth International Symposium on the Reactivity of Solids, Amsterdam, 1960. J. H. De Boer, et al. eds. Amsterdam, Elsevier Publishing Company, 1960. (WAPD-T-1155)

Results of a series of studies on solid state diffusion processes and the mechanism of material transport within the uranium dioxide lattice are presented. The kinetics of both self-diffusion (cation and anion) and fission gas diffusion in the UO_2 fluorite lattice were measured. Oxygen ion self-diffusion coefficients in both stoichiometric and non-stoichiometric uranium dioxide were determined by means of the isotopic exchange reaction between uranium dioxide powders of normal O^{16} content and carbon dioxide gas enriched in O^{18}. For stoichiometric UO_2, oxygen ion self-diffusion is given by the relationship, $D = 1.2 \cdot 10^3 \exp(-65{,}300/RT)$, for the temperature range 550 to 780°C; the activation energy for oxygen ion self-diffusion in non-stoichiometric uranium dioxide was found to be 29.7 kcal/mole, in good agreement with activation energies found in studies on the oxidation of UO_2. In both stoichiometric and non-stoichiometric uranium dioxide, the diffusion step is considered to be one in which an interstitial ion and a lattice ion move in combination, the lattice ion moving into an available neighboring interstitial site and the interstitial ion moving into the vacated lattice site. Thus, equilibration and diffusion both occur in the same combined step. A mechanism such as this, which has been called "interstitialcy diffusion", seems from steric considerations alone, preferable to one in which motion is directly between interstitial positions and equilibration results from a direct interstitial-lattice exchange. In the non-stoichiometric oxide the diffusion current carriers are interstitial oxygen anions. In stoichiometric UO_2, Frenkel-type defects are produced thermally. A lattice oxygen moves into a vacant interstitial position creating a lattice vacancy and an interstitial oxygen ion. The energy to form a Frenkel defect in UO_2 is estimated to be about 71.2 kcal/mole from the activation energy for diffusion (65.3 kcal/mole) and the energy barrier for defect motion (29.7 kcal/mole). Self-diffusion coefficients for uranium in UO_2, were determined by the method of surface activity decrease. The experimental diffusion couple consisted of a very thin layer of alpha-active UO_2 (the principal alpha radiation is that due to the U^{234} isotope) deposited on relatively alpha-inactive sintered, high density UO_2 pellets. This geometry approximates that of a semi-infinite solid with an instantaneous source of diffusing material. High-temperature diffusion anneals were conducted in a hydrogen atmosphere with the active faces of two diffusion couples touching. Diffusion coefficients were calculated from the initial surface activity, the final surface activity after a diffusion anneal, the effective alpha range in UO_2, and the time of annealing. The equation for uranium self-diffusion in UO_2 can be represented by $D = 4.3 \cdot 10^{-4} \exp(-88{,}000/RT)$ over the temperature range 1450 to 1785°C; the activation energy is 88.0 kcal/mole with a probable error of 11.0 kcal/mole. Diffusion coefficients for the fission gases Kr^{85} and Xe^{133} were determined from kinetic measurements of the fraction of the total gas isotope produced during irradiation which is released during a high-temperature post-irradiation anneal. Uranium dioxide powders as well as UO_2 solids of various geometries, densities, and radiation exposures were examined. Gamma ray spectrometric techniques were used to identify and count the particular fission gas isotope. The diffusion system is considered to be an assembly of uniform spherical regions in which the controlling parameter is the radius of an equivalent hypothetical sphere of the same ratio of surface area to volume. The effective surface area is considered to be that determined by the Brunauer-Emmett-Teller (BET) gas adsorption method. Although there is considerable scatter in the diffusion coefficient data for both Kr^{85} and Xe^{133}, the general features of an Arrhenius plot show an activation energy for both krypton and xenon fission gas diffusion to be similar to that for uranium ion diffusion in UO_2. A mechanism for fission gas lattice diffusion is suggested and compared with cation and anion diffusion in the UO_2 fluorite lattice. (auth)

27687 THE PROTECTION OF METALS AT HIGH TEMPERATURES. E. S. Bartlett (Battelle Memorial Inst., Columbus, Ohio). Paper 511C, National Aeronautic Meeting, April 3-6, 1962, New York. New York, Society of Automotive Engineers, Inc., [1962]. 30p.

High-temperature performance of coated metal systems is affected by reaction of the coating with the environment and interaction between the coating and substrate. Both coating and substrate selection are important. Coating-application techniques are equally important to material parameters in establishing system performance. Intermetallic diffusion coatings (e.g., silicides and aluminides) are of principal interest in protecting the refractory metals (e.g., niobium, molybdenum, tantalum, and tungsten) from oxidation. Major application techniques include vapor deposition and slurry processes. Use of coated molybdenum parts is reported; however, the general status of coated refractory metals is largely developmental. (auth)

27688 MAGNESIUM BASE ALLOYS. Philip Andrew Fisher and Eric Arthur Walker (to Magnesium Elektron Ltd.). British Patent 903,584. Aug. 15, 1962.

An Mg alloy having high creep resistance and good maximum tensile stress at high temperatures up to 300°C without heat treatment comprises Th 0.7 to 0.85 wt %, Zn 0.25 to 0.75 wt %, Zr 0 to 1.0 wt %, and balance Mg. The tensile properties may be improved further by double extrusion. (D.L.C.)

27689 NEW COMPOSITE THERMAL INSULATION MATERIAL. (to Commissariat à l'Énergie Atomique). French Patent 1,248,467. Nov. 7, 1960.

A thermal insulation material is described that is composed of a pile of thin metal sheets, each sheet being covered, at least at one of its faces, by a thermal insulation. This insulation is constituted by a refractory material in a fibrous or pulverulant state (e.g., refractory oxides, amiantus, glass, or silica), these materials forming a discontinuous layer adherent to the surface of the metal sheet. In other embodiments of the insulation the sheets may be perforated or replaced by thin wire nettings. In case the insulation is used in nuclear reactors, the metal sheets are made of materials that are slow-neutron absorbers, or very thin steel sheets are used that are covered with a thick layer of insulating material having a high slow-neutron absorption coefficient. For making this composite thermal insulation, the insulation material is preferably mixed with an appropriate binder in order to form a paste, and placed on the sheets before forming the stack. The mutual binding of sheet and insulation material is performed afterwards, e.g., by increasing the temperature. (NPO)

27690 HIGH DENSITY NUCLEAR FUEL COMPOSITION. F. B. Litton (to U. S. Atomic Energy Commission). U. S. Patent 3,044,946. July 17, 1962.

A nuclear fuel consisting essentially of uranium monocarbide and containing 2.2 to 4.6 wt % carbon, 0.1 to 2.3 wt % oxygen, 0.05 to 2.5 wt % nitrogen, and the balance uranium was developed. The maximum oxygen content was less than one-half the carbon content by weight and the carbon, oxygen, and nitrogen are present as a single phase substituted solid solution of UC, C, O, and N. A method of preparing the fuel composition is described. (AEC)

27691 HIGH TEMPERATURE NIOBIUM BASE ALLOY. Neil M. Lottridge, Jr. (to General Motors Corp.). U. S. Patent 3,046,109. July 24, 1962.

A Nb base alloy is described which has high hot strength, fabricability, and oxidation resistance at high temperatures up to 2000°F. The alloy consists of 2 to 5% Ti, 9 to 11% Mo, 4 to 8% Cr, 0.5 to 2% Zr, and balance Nb. The alloy is especially suited for use in gas-turbine blades. (D.L.C.)

Radiation Effects

Refer also to abstract 28378.

27692 (ASD-TDR-62-12) SEMICONDUCTOR DIODE PERFORMANCE IN NUCLEAR RADIATION ENVIRONMENTS. Harlan G. Hamre, Raymond C. Barrell, and William N. McElroy (Illinois Inst. of Tech., Chicago. Armour Research Foundation). May 1962. Contract AT 33(616)-7329. 87p.

Performance characteristics were determined for two types of general purpose diodes, and for five types of microwave diodes, in radiation environments equivalent to at least 1000 hours' exposure to 10^{10} neutron/cm^2-sec and 2×10^5 rad/hr. None of the units studied showed satisfactory performance characteristics after the exposure, although germanium 1N263 point-contact diode was degraded less than others investigated, and still exhibited measurable properties following the exposure. Results, seem to indicate that energizing the microwave mixers at x-band (9375 Mc) during radiation is helpful in prolonging the life of the units. (auth)

27693 (HW-72322) FUEL ELEMENT STATISTICS FROM THE QUALITY CERTIFICATION PROGRAM. L. T. Hagie and J. L. Jaech (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 16, 1962. Contract [AT(45-1)-1350]. 12p.

The Quality Certification Program investigates the irradiation behavior of normal produced fuel elements. The dimensional variations and hot-spot performance in I & E natural fuel elements canned during the period July 1959 through May 1961 are summarized. The results show that the fuel quality is highly variable with time. A rank correlation coefficient of 0.80 was determined between warp and percent hot-spots on normal production fuel. Since May 1960 a dramatic but unexplained reduction in warp was observed. Post-irradiation, the diameter at the center is about 4 mils larger on the average than the outside diameters of the base end cap. Thus, fuel elements tend to swell in the middle causing a barrel shaped profile. A decrease in total porosity as measured by total bond count was observed over the period. (N.W.R.)

27694 (ORNL-TM-299) AN ESTIMATE OF THE EFFECT OF NEUTRON-ENERGY SPECTRUM ON RADIATION DAMAGE OF STEEL. H. C. Claiborne (Oak Ridge National Lab., Tenn.). July 27, 1962. Contract [W-7405-eng-26]. 15p.

The postulate that the average number of lattice displacements is directly proportional to the available energy is carried one step further; it is assumed that damage to steel (particularly in regard to brittle fracture) is proportional to the number of lattice vacancies that occur. The model, although crude, permits estimation of the relative damage resulting from differences in neutron spectra. The results can be used as a rough method of correcting damage data for the effect of the neutron-energy spectrum. Radiation damage calculations for steel, relative to those for a fission spectrum, were made for neutron spectra that result from fission neutrons penetrating water or graphite. The results were plotted as a function of effective distance from the fission source. From this plot it is possible to make a conservative estimate of the correction factor to apply to damage data obtained with different neutron spectra. (auth)

27695 (TID-16373) LOW TEMPERATURE ANNEALING SPECTRUM OF ELECTRON-IRRADIATED GOLD AND CADMIUM (thesis). Technical Report No. 28. Walter Bauer (Illinois. Univ., Urbana). June 1962. Contract AT(11-1)-182. 50p.

The resistivity annealing spectrum from 8 to 51°K of the damage produced by a flux of 7.5×10^{17} 3 Mev electrons/cm^2 on 99.999% pure gold and cadmium was studied. The total damage and residual resistivity for gold was 8.5×10^{-9} and 3×10^{-9} ohm-cm, and for cadmium 2.32×10^{-9} and 5.3×10^{-9} ohm-cm. The gold activation energy spectrum was derived directly from the isothermal annealing curves. The spectrum consists of at least nine peaks, with 22% of the damage annealing out up to 51°K. The results confirm earlier suggestions that the radiation damage in gold is basically different from that of copper and silver. In connection with the amount of low temperature annealing, it is thought that focusing and interstitial clustering is important. Deviations from Mathiesson's rule for gold and cadmium are in qualitative agreement with theory. Only qualitative agreement with an earlier experiment on the annealing of cadmium was confirmed. (auth)

27696 (WCAP-1680) RADIATION EFFECTS ON THERMOELECTRIC MATERIALS. G. R. Kilp and P. V. Mitchell (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). May 1961. Contract AT(30-3)-500. 50p.

Measurements were made of the thermoelectric properties of thermoelectric compounds during irradiation, and pre- post-irradiation. The tests are described and data presented. For the materials $Li_xNi_{1-x}O$, GeTe, Bi_2Te_3, PbTe, and $Bi_{.05}Ge_{.95}Te$, it was found that when the thermoelectric material was irradiated at reactor ambient temperatures and slightly above (50 to 100°C), the usual result was an increase in electrical resistivity and Seebeck coefficient. In most cases, this resulted in a decrease in the term α^2/ρ (power number), which would be reflected in a decrease in the thermoelectric figure of merit, assuming no decrease in the thermal conductivity. Raising the average temperature of the sample to 150 to 200°C tended to anneal out the incurred damage for most of the materials tested. The material which best appeared to resist irradiation damage was $Bi_{.05}Ge_{.95}Te$. However, the results indicated that most thermoelectric materials have some temperature where the irradiation damage annealing equals the damage rate, so that no net change occurs in that material's figure of merit. (auth)

27697 (AEC-tr-5170) IRRADIATION DEVICES CONSTRUCTED AT THE GRENOBLE CENTER OF NUCLEAR STUDIES. (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Grenoble). Translated for Oak Ridge National Lab., Tenn. 1961. 33p.

Special emphasis is on the development, design, construction, and performance of neutron diffractometers, in-pile loops, and radiation target cans. (N.W.R.)

27698 (AEC-tr-5245) EFFECTS OF NEUTRON IRRADIATION ON THE ORDERED ALLOY Fe_3Al. G. P. Saenko. Translated from preprint SM25/86 presented at IAEA Symposium on Effects of Neutron Emission on the Electric Resistance of Certain Metals held in Vienna, May 7-11, 1962. 18p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 22705.

27699 (AEC-tr-5257) RELAXATION OF ELASTIC STRESS IN MATERIALS UNDER THE ACTION OF RADIATION. P. A. Platonov. Translated by R. Berman (Westinghouse Electric Corp., Bettis Atomic Power Lab., Pittsburgh) from Symposium on Radiation Damage on the Solid State and Reactor Materials, Venice. 20p.

Experiments are described on the relaxation of elastic stresses in a series of materials (Ni, W, Mo, Fe, Zr, stainless steel, and nichrome) under neutron irradiation. It is shown that irradiation to 10^{19}-10^{20} nvt at temperatures of 120-140°C causes an observable relaxation in the majority of materials. Relaxation under irradiation was found to be slightly dependent on temperature and on the stress applied. Radioinduced relaxation was observed to cause up to 70% recovery under irradiation. The after-effect tends to be reduced with an increase in radiation dose. In Ni and W, the kinetics were investigated, throwing some light on the mechanism of radioinduced relaxation. (auth)

27700 (AEC-tr-5263) EFFECTS OF NEUTRON IRRADIATION ON THE ELECTRIC RESISTANCE OF CERTAIN METALS. N. F. Pravdyuk and A. N. Ivanov. Translated from Paper SM-25/87 Presented at the Symposium on Effects of Neutron Emission on the Electric Resistance of Certain Metals, Venice, May 7-11, 1962. 32p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 22706.

27701 MULTIPLE THERMAL POINTS PRODUCED BY IRRADIATION IN METALS. A. Corciovei and D. Grecu (Inst. for Atomic Physics, Bucharest). Acad. rép. populaire Roumaine, Rev. phys., 6: 363-83(1961). (In French)

Under the action of neutrons or charged particles, properties of solids are modified depending both on the nature of the radiation and the nature of the solid. The physical conditions necessary for the production of multiple thermal points are calculated, and then the mean free path of the incident particle is considered. The dimensions of a multiple thermal point and the properties of a spherical multiple thermal point are analyzed. (J.S.R.)

27702 OXIDATION OF SILVER INDUCED BY NUCLEAR RADIATION. M. Nachman, G. Glanz, and L. Rîbco (Inst. for Atomic Physics, Bucharest). Acad. rép. populaire Roumaine, Rev. phys., 6: 403-9(1961). (In English)

Silver foils and wires exposed to neutrons and γ rays were oxidized at temperatures at which, in the absence of radiation, only a monomolecular oxide surface film is formed. Oxidation is predominantly caused by γ rays which produce O^- and O_2^- ions. (tr-auth)

27703 SOLUTION HARDENING BY TETRAGONAL DISTORTIONS: APPLICATION TO IRRADIATION HARDENING IN F.C.C. CRYSTALS. Robert L. Fleischer (General Electric Research Lab., Schenectady, N. Y.). Acta Met., 10: 835-42(Sept. 1962).

It is pointed out that solution hardening is generally of two types: gradual and rapid. Rapid hardening is attributed to tetragonal distortions, and a general statement of a theory is made. Specific calculations are applied to the case of the irradiation hardening of copper by neutron bombardment. Agreement was obtained with both the observed flux variation of the hardening and its absolute magnitude. For γ irradiation on LiF similar agreement was found. (auth)

27704 ON β CONDUCTIVITY IN GERMANIUM (CONDUCTIVITY OF GERMANIUM INDUCED BY ELECTRON BOMBARDMENT). A. Zarębа (Inst. of Physics, Polish Academy of Sciences, Warsaw). Acta Phys. Polon., 21: 371-87(Apr. 1962). (In English)

Conductivity in homogeneous single germanium crystals is produced by electron bombardment. The mean effective energy ϵ of electron-hole pair generation was measured. The method of exclusion was applied, making possible the simultaneous determining of τ and ϵ for the additional current carriers generated. At $1.5 < E_0 < 30$ kev, $\epsilon = 3.8 \pm 0.4$ ev. For $E_0 < 2$ kev, the essential part is played by the nonsensitive layer on the crystal surface. From a comparison of the results obtained in measuring ϵ and the characteristic losses, conclusions are made as to the role of plasmons in the mechanism leading to the appearance of β-conductivity in germanium. (auth)

27705 RADIATION EFFECTS IN ORGANIC COOLANTS AND MODERATORS. K. A. Nater and J. J. M. Snepvangers. Atoomenergie, 4: 133-41(July 1962). (In Dutch)

Many organic liquids have been examined for their behavior at high temperatures and under irradiation. Polyphenyls and aromatic compounds with condensed ring systems prove to be the most radioresistant. Many of these materials have been irradiated both in test loops and materials testing reactors. The present article gives an indication of the work done in this area. (tr-auth)

27706 CONTRIBUTION TO THE RADIOCRYSTALLOGRAPHIC STUDY OF THE EFFECT OF NEUTRONS OF LiF MONOCRYSTALS. M. Dubois and M. Tournarie (Centre d'Etudes Nucleaires, Saclay, France). Bull. soc.

franc. minerol. et crist., 84: 353-63(1961). (CEA-2151). (In French)

Changes in the 200 and 400 reflections in LiF monocrystals irradiated by neutrons are studied, for doses between 10^{17} and 10^{18} n/cm^2. The reflections are distinctly dissymmetric and in the case of doses under 5×10^{17} n/cm^2 appear to consist of a fine peak associated with a wide and diffuse base. There appear to exist organized groups of point defects, which lead to perturbed zones whose number varies very little with the irradiation, and which exist perhaps before irradiation. (auth)

27707 KINETICS OF RADIATION INDUCED CONDUCTIVITY CHANGES IN ZINC OXIDE. K. Klier and T. I. Barry (Wantage Research Lab., Berks, Eng.). Collection Czechoslov. Chem. Communs., 27: 1320-2(May 1962). (In English)

The observation that adsorption of hydrogen and isobutene on ZnO greatly increases the γ-induced conductivity was explained qualitatively in terms of trapping of radio-induced holes at adsorbed hydrogen or isobutene molecules leaving the electrons to increase the conductivity. A simple quantitative treatment of the kinetics of this process is made and compared with the experimental data. The results support the proposed mechanism based on competition for holes between adsorbed molecules and electrons. (J.S.R.)

27708 STUDY BY X-RAY SCATTERING OF FAULTS FORMED IN A LITHIUM FLUORIDE MONOCRYSTAL IRRADIATED WITH THERMAL NEUTRONS AT –195°C. Marianne Lambert, Simone Lefebvre, and Andre Guinier (Laboratoire de Physique des Solides, Faculte des Sciences, Orsay, France). Compt. rend., 255: 97-9(July 2, 1962). (In French)

At room temperature and during the annealing of samples at increasing temperatures, the presence of "large" faults characterized by a remarkable homogeneity in shape is observed. (tr-auth)

27709 RAMAN SCATTERING IN α-QUARTZ IRRADIATED WITH FAST NEUTRONS. V. G. Zubov and L. P. Osipova (Moscow Univ., USSR). Doklady Akad. Nauk S.S.S.R., 144: 763-5(June 1, 1962). (In Russian)

The density of a quartz cube $30 \times 30 \times 30$ mm decreased from 2.65 to 2.49 g/cm^3 on irradiating with fast neutrons. The quartz acquired a light violet color and absorbed about 50% of the light incident on the cube at 4000 to 5800 Å. The sample showed a strong fluorescence with a maximum at λ = 5750 Å. The Raman spectra of the irradiated sample were compared with the corresponding spectra for unirradiated crystalline quartz and for fused quartz. Raman scattering in the irradiated quartz sample was similar to a continuous spectrum containing a large number of diffuse maxima. The spectral intensity of the irradiated quartz was significantly less than the intensity of the corresponding spectral lines of unirradiated quartz, especially in the 100 to 500 cm^{-1} region. In the 100 to 700 cm^{-1} region, the intensity of light scattered along the z axis was almost a factor of two less than the intensity of scattering along the x or y axis. An anomalous increase in the intensity of scattering was observed in the anti-stokes region as compared to the Stokes region. (TTT)

27710 THE IRRADIATION OF GLASSES. P. S. Rudolph (Oak Ridge National Lab., Tenn.). Fusion, 9: 9-16(Feb. 1962).

Radiation effects on glass are discussed. The properties of ionizing radiations are described. The changes in the properties of various glasses after irradiation are also described. (M.C.G.)

27711 RADIATION DAMAGE IN SOLIDS. A Scharmann (Universität, Giessen, Ger.). Kerntechnik 4: 159-61(Apr. 1962). (In German)

An outline is given of the effects of high-energy radiation (photons, neutrons, and charged particles) on solids. Attention is given to the penetration depths of radiations, the production of Frenkel pairs, replacement collisions, disordering collisions, and cascade collisions. The general correlation between fast neutron doses and the extents of radiation damage to several general classes of materials is summarized. (T.F.H.)

27712 DEPENDENCE ON TEMPERATURE OF THE INTERLAYER SPACING OF IRRADIATED GRAPHITES. B. P. Jackets and D. J. Dyson (General Electric Co., Ltd., Wembley Middx., Eng.). Nature 195: 680-1(Aug. 18, 1962).

An investigation was made to determine whether or not crystal expansion coefficients of heavily irradiated graphites differ from the coefficients of lightly or unirradiated materials. Lattice contraction on cooling to liquid nitrogen temperature was studied. The magnitude of contraction, over the temperature range examined, was substantially the same, within the limits of experimental error, for three different samples. However, at –190°C, there was a tendency for the contraction to decrease slightly with increasing neutron irradiation dose. The rate of interlayer spacing contraction of all the samples below room temperature was less than the rate of expansion of the unirradiated samples above room temperature. It was concluded that there is still no firm indication that observed changes in bulk properties of graphites on irradiation are dependent on changes in the crystal expansion coefficients. (P.C.H.)

27713 EFFECTS OF NUCLEAR RADIATION ON ELECTRICAL CONDUCTIVITY OF CHROMIC OXIDE. M. Nachman and L. Cojocaru (Inst. of Atomic Physics, Bucharest). Nature, 195: 694-5(Aug. 18, 1962).

The effects of nuclear radiation on the electrical conductivity of pure chromic oxide (Cr_2O_3) were investigated. Electrical measurements were made on temperature-dependence of the electrical conductivity of samples in the range 350 to 950°K, before and after exposure to an integrated fast neutron flux of 4×10^{17} neutrons/cm^2; and on time-dependence of electrical conductivity of the samples during in-pile exposure to an integrated fast neutron flux of 2×10^{17} neutrons/cm^2. The nuclear radiations caused two kinds of effects in chromic oxide which manifest themselves in changes in electrical conductivity. Ionization effects which lead to a rise in the conductivity due to the generation of charge carriers in excess; these effects are not permanent, they disappear after cessation of radiation. Displacement effects which lead to a decrease of the conductivity due to formation of trapping centers in the chromic oxide lattice; these effects are permanent at room temperature but can be annealed at higher temperatures. Below annealing temperature, the temperature-dependence of the electrical conductivity of chromic oxide is not affected by irradiation. (P.C.H.)

27714 ON STABILITY OF A CIRCULAR PLATE SUBJECTED TO IRRADIATION. Yu. I. Remnev. Nauch. Doklady Vysshei Shkoly, Fiz.-Mat. Nauki, No. 3, 145-7 (1959).

The critical value of volumetric expansion for a circular plate of given dimensions subjected to symmetrical two-sided irradiation with neutrons is calculated. The effects of temperature rise, nuclear transformations and Frenkel defects are taken into account. The Galerkin method was used to determine critical stresses. (Referativnyy Zhurnal, 12: No. 8, 1961)

27715 CAPSULE IRRADIATIONS OF A PASTE OF URANIUM–10 wt % MOLYBDENUM POWDER IN NaK. E. C. Kovacic (Atomic Power Development Associates, Inc., Detroit), Paul R. Huebotter, and John E. Gates. Nuclear Sci. and Eng., 13: 378–84(Aug. 1962).

Two in-pile capsule experiments have been performed to study the behavior during irradiation of a "paste" of fissionable particles settled at maximum density in a liquid-metal medium. The paste consisted of 150-μ nominal diameter, spherical particles of U–10 wt % Mo alloy in NaK and was irradiated to burnups of 0.0055 and 0.061 total at % in the Battelle Research Reactor. The irradiation capsule consisted essentially of a tube divided into two compartments by an orifice plate. The inside diameter of twin orifice tubes, projecting in either direction from the orifice plate, was such that the paste could flow by gravity from one compartment to the other. An underwater device to measure the gamma-ray emission from the irradiated fuel was used to check the mobility of the paste between increments of irradiation. The paste in the first experiment failed to flow after the first increment of irradiation, and examination of the capsule and particles failed to provide an explanation. The second experiment, performed after some refinements in procedure, was more successful. The mobility of the paste was demonstrated up to a burnup of 0.031 total at %, after which the flow became very sluggish even when assisted by vibration. Examination of the paste indicated that a buildup of oxide contamination in the capsule probably caused the sluggishness of the paste. There was no evidence in either experiment of particle agglomeration by a sintering or fission welding mechanism. (auth)

27716 IRRADIATION DAMAGE IN MOLYBDENUM AFTER ENERGETIC H^+ AND He^{++} ION BOMBARDMENT. C. J. Beevers (Central Electricity Generating Board, London) and D. J. Mazey. Phil. Mag. (8), 7: 1061–4(June 1962). (AERE-M-991)

Mo sheets were exposed to 38-Mev alpha particles to a dose of 1.5×10^{17} ions and to 85-kev protons to a dose of 6×10^{18} ions; the sheet thicknesses were 0.003 in. and 2000 Å, respectively. The sheets were 99.98% pure and had a grain size of about 2 microns. Photomicrographs are shown of samples in which the alpha particles passed through the sheet, in which the alpha particles stopped in the sheet, and in which the protons passed through the sheet. The defects produced are discussed. (T.F.H.)

27717 ON THE MECHANISM OF VACANCY ANNIHILATION IN NEUTRON IRRADIATED MOLYBDENUM. J. F. Korridge, S. S. Sheinin, A. A. Johnson, and H. I. Matthews (Imperial Coll. of Science and Tech., London). Phil. Mag. (8), 7: 1073–5(June 1962).

Commercial-purity 0.0005-in. Mo foils were annealed at 1250°C, then exposed to reactor neutrons to an integral dose of 10^{19} nvt at 30 to 40°C. About 10% of the neutrons had an energy above 1 Mev. Electron microscope studies were made of samples that were unirradiated, irradiated, and irradiated and subsequently annealed for one hour at 125 to 300°C. No dislocation loops were observed in the irradiated or irradiated-and-annealed samples; the system used could detect dislocation loops with diameters down to 25 Å. It is concluded that the formation of dislocation loops is not one of the mechanisms by which vacancies in Mo are annihilated, and that loops are not formed during irradiation by defects (e.g., interstitials) that are mobile at the ambient reactor temperature. (T.F.H.)

27718 ELECTRON-SPIN PARAMAGNETIC RESONANCE STUDIES OF IRRADIATED ALUMINO–SILICATE GLASSES. Sook Lee and P. J. Bray (Brown Univ., Providence). Phys. and Chem. Glasses, 3: 37–42(Apr. 1962).

Electron-spin paramagnetic resonance (ESPR) spectra were obtained at both room and liquid nitrogen temperature from several alumino–silicate glasses, and one soda-alumino–silicate glass, which have received x-ray or neutron irradiation. Two distinct types of resonance were observed in alumino–silicate glasses after x-ray irradiation. One is partially resolved into six equally spaced lines with a separation of 8.1 gauss between adjacent lines; the other resonance is an asymmetric line with a width of approximately 18 gauss between inflection points of the absorption curve. The latter resonance is more readily observed after heating the sample to 350°C, at which temperature the resonance exhibiting the six equally spaced lines disappears. It is suggested that the six-line structure arises from a hole trapped on a bridging oxygen which is bonded to a substitutional Al^{-} ion, and that the broad asymmetric resonance is due to a hole trapped on a non-bridging oxygen. The measurements of the ESPR intensity of these resonances as a function of Al_2O_3 content in the glasses indicate that the impurity ions which enable some Al^{-} ions to substitute for Si atoms are contained in the SiO_2 employed, and that in addition, Al_2O_3 can act as a modifier oxide and produce non-bridging oxygen ions. Only the broad asymmetric resonance is observed in the x-ray irradiated soda-alumino–silicate glass; the Na_2O is principally responsible for the non-bridging oxygens on which holes are trapped when this glass is x-ray irradiated. Neutron irradiation of all of the glasses produces the same spectra of x-ray irradiation except for the addition of a single sharp, intense line which is ascribed to trapped electrons in the silica network. (auth)

27719 PRODUCTION AND RECOVERY OF ELECTRON-INDUCED RADIATION DAMAGE IN A NUMBER OF METALS. P. G. Lucasson and R. M. Walker (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev., 127: 485–500(July 15, 1962).

The changes in residual electrical resistance produced by bombardment with high-energy electrons were measured for a number of metals as a function of electron energy in the range from 0.5 to 1.4 Mev. The irradiations were performed at ≈20°K, and recovery measurements were made up to 300°K. The production curves were analyzed using simple displacement theory and the following values were found for the average threshold energies: Al, 32 ev; Au, >40 ev; Ag, 28 ev; Cu, 22 ev; Fe, 24 ev; Mo, 37 ev; Ni, 24 ev; Ti, 29 ev; and W, >35 ev. Approximate values for the resistivities of Frenkel pairs (in units of μΩ cm per at. %) were also obtained as follows: Al, 3.4; Ag, 1.4; Cu, 1.3; Fe, 12.5; Mo, 4.5; Ni, 3.2; and Ti, 42. In the case of Al it was necessary to take secondary defect production into account and a number of representative theoretical curves, based on different assumptions concerning the process of secondary defect production, are included. The behavior of Zn was anomalous in that the added resistivity was not a linear function of electron dose at 20°K. (auth)

27720 DEFECTS PRODUCED IN n-TYPE GERMANIUM BY IRRADIATION WITH HIGH-VELOCITY ELECTRONS. B. M. Konovalenko, S. M. Ryvkin, and I. D. Yaroshetskii (Ioffe Inst. of Physics and Tech., Leningrad). Soviet Phys.-Solid State, 4: 272–5(Aug. 1962).

The temperature dependence of the Hall coefficient in n-type germanium after irradiation using high-velocity electrons was investigated. The number of acceptor

levels and the cross section for radiation defects formation were determined. (auth)

27721 THE CHANGE IN SURFACE PROPERTIES OF p-TYPE SILICON UPON BOMBARDMENT BY LITHIUM IONS. M. M. Bredov and A. B. Nuromskii (Inst. of Semiconductors, Leningrad). Soviet Phys.-Solid State, 4: 409-11(Aug. 1962).

Donor states can be obtained in a semiconductor by ionic bombardment under definite experimental conditions. By bombardment of p-type Si by Li ions, an occluded layer can be obtained at a depth responsible for the valve photoeffect. (L.N.N.)

27722 STUDY OF FACTORS CONTROLLING THE RELEASE OF XENON-133 FROM BULK UO_2. D. F. Toner and J. L. Scott (Oak Ridge National Lab., Tenn.). p.86-99 of "Symposium on Radiation Effects in Refractory Fuel Compounds." Special Technical Publication No. 306. Philadelphia, American Society for Testing and Materials, 1961.

The postirradiation anneal technique was used to determine the release rate of xenon-133 from 95 per cent dense UO_2 pellets between 1000 and 2000°C. The information was required for design of the Experimental Gas-Cooled Reactor fuel elements. Release rate measurements indicated that below the sintering temperature, an initial rapid release of xenon was followed by a slower diffusion-controlled release. The release rate parameter, D' (where $D' = D/a^2$), ranges between 10^{-10} and 10^{-14} per sec at 1400°C. These data are related to the total surface area of the pellet by the equation: $\log D'_{1400°C}(sec^{-1}) = -14.0 + 2 \log S.A.(cm^2/g)$. Below approximately 1600°C, the rate of release can be explained in terms of the equivalent sphere model for fission-gas release. Above approximately 1600°C, the rate of release is higher than would be predicted on the basis of diffusion. The release rate data were compared with the release rates obtained in-pile. Results showed that the release rate was independent of burnup up to 16,400 Mw days per metric ton of UO_2. (auth)

27723 METHOD OF LUBRICATING METAL PARTS EXPOSED TO NUCLEAR RADIATION AND HOT CARBON DIOXIDE. Arthur L. Morris (to Esso Research and Engineering Co.). U. S. Patent 3,046,223. July 24, 1962.

A grease composition is described which is resistant to heat, carbon dioxide, and radiation. The grease comprises a base mineral oil thickened to a grease consistency with carbon black and containing one or more natural petroleum resins. The carbon black preferably is acetylene black, and the resins may be obtained from resin-containing crudes. The grease composition should have a small sulfur content, preferably less than 0.5%, and a small amount of antioxidant may be added. (D.L.C.)

27724 MEASUREMENT OF RADIATION. Jean A. Paymal (to Compagnie de Saint-Gobain, Paris). U. S. Patent 3,046,400. July 24, 1962.

A manganese glass for use as a colorimetric radiation detector is described which is color-stable after irradiation and gives a color proportional to the quantity of radiation but independent of the radiation intensity. A metal oxide is incorporated into the glass which acts as a radiation intensity-compensating agent. The agent may be chosen from the group of Fe, Sn, V, and Cr; the combination of V and Cr also increases the sensitivity of the glass to radiation. (D.L.C.)

PHYSICS

General and Miscellaneous

Refer also to abstract 27643.

27725 (AD-269126) STUDY OF CRATER PHYSICS. Report No. 3. Final Report, December 19, 1960 to July 19, 1961. J. F. Friichtenicht (Space Technology Labs., Inc. Research Lab., Canoga Park, Calif.) July 18, 1961. For Thompson Ramo Wooldridge Inc., Cleveland. Contract NAS5-763, Subcontract C135A-1043. 31p. (8980-0003-RU-000)

Work performed on calibration and study of various meteorite detectors is reviewed. Dynamic measurements are reported for detectors designed to utilize impact flash, impact ionization, and momentum transfer effects; microphone detectors used to study the production of a signal particle impact are also reviewed. (auth)

27726 (HW-73116) PHYSICS RESEARCH QUARTERLY REPORT, JANUARY–MARCH, 1962. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 16, 1962. Contract AT(45-1)-1350. 128p.

A total of 13 papers is included for each of which a separate abstract was prepared. (J.R.D.)

27727 (HW-73116(p.4-16)) THE MODIFIED HEAVY GAS MODEL AND TWO THERMAL GROUP RETHERMALIZATION THEORY. C. W. Lindenmeier (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The heavy gas model and associated Wilkins equations are attractive for deriving neutron spectra; however, the model does not give an adequate description for materials and energies where binding effects are important. The gas model was modified so that the cross section weighted average energy loss per collision from an arbitrary Maxwellian spectrum is correctly reproduced. The accuracy of the gas model was investigated by calculating the modification to the Wilkins equation using the code KRYOS-II and comparing the spectrum calculated directly from the kernel by the code SPECTRUM with the spectrum obtained from the modified Wilkins equation. The theoretical spectra and the experimental results agree closely. The importance of the cross section weighted average energy loss is particularly evident in rethermalization phenomena. In the case of graphite at room temperature the modified Wilkins equation gives a successful description of measured spectra. It is noted that by means of rethermalization-type experiments the energy transfer characteristics of a moderator in question can be examined using a Maxwellian spectrum as a probe. (J.R.D.)

27728 (HW-73116(p.17-22)) CALCULATION OF THE FAST FISSION PARAMETER δ. C. R. Richey (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A model for calculation of the ratio of fast fissions in U^{238} to fissions in U^{235} is suggested (fast fission effect) which includes the interaction effect. The method should be applicable to solid rods, hollow rods, internally and externally moderated rods (I & E), and tube-in-tube fuel assemblies. The method was found to produce results in good agreement with experiment. (J.R.D.)

27729 (HW-73116(p.23-31)) ANALYTIC INTEGRATION OF THE SOLID ANGLE FUNCTIONS RELATING TO SUBCRITICAL INTERACTIONS. F. R. Czerniejewski (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Methods of treating the problem of safe handling of fissile elements are examined. A method of analytic integration of the probability that a neutron will leave one component and enter another is presented. The results are tested against the measured critical systems in terms of k_{eff} and the critical separation. The geometrical approximations are found to be appreciably smaller than the cross sections and diffusion theory. It is noted that a normalization could be made by dividing each k_{eff} by the value predicted for an infinite separation. The values would then agree very well with the measurements. (J.R.D.)

27730 (HW-73116(p.32-6)) WORTH OF A CONTROL ROD IN A SPHERICAL CRITICAL ASSEMBLY. W. A. Reardon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The behavior of the flux or power level of a Pu solution critical assembly prompted an attempt to compute the worth of the control rod. It was noted that as the rod was withdrawn from an experimental solution, which was both subcritical and not full, the power rose as expected initially, then turned downward for a while, until the rod was completely withdrawn at which time the flux leveled off. The explanation offered is that since the rod is inserted directly into the solution (there is no re-entrant tube) the worth of the rod in displacing solution, thereby improving the geometry and decreasing leakage, is greater than the worth of the rod as a poison over the first few centimeters of travel. The approach used in this explanation of the control rod-power behavior is somewhat lacking from the point of view of complete understanding, but a way is pointed toward getting better answers. It has the advantage of providing reasonably good agreement with the experimental values obtained from the critical mass experiments. Further experiments would be needed to more firmly establish the model. The reason for uncertainty about the model lies in the fact that the two volumes considered were quite different. The weighting of the rod length by φ^2 is based upon a bare sphere (critical) at 33.8 g/l of Pu while the displacement worth is based upon the actual volume of a critical concrete reflected sphere of 33.8 g/l of Pu. The use of equivalent bare spheres would be expected in either case, with suitably truncated functions of weighting. This is done in the case of the poison worth, but not in determining the coefficient of the displacement. This may be because of the air gap at the top of the solution (F (full) = 23.22 l); that is, the solution does not actually suffer displacement until the rod touches the surface. The displaced solution then tends to fill the air gap, improving the geometry. The immediate positive result of this is to provide a systematic means of correcting measured critical volumes for fractions of the control. (J.R.D.)

27731 (HW-73116(p.37-50)) MEASUREMENT OF FAST NEUTRON TOTAL CROSS SECTIONS USING A CONTINUOUS SPECTRUM. D. G. Foster, Jr. and D. W. Glasgow (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (HW-SA-2522)

An experiment is described to measure total cross sections of a wide range of elements and isotopes for neutrons at 3 to 15 Mev. The measurement is made by a straightforward transmission time experiment. Neutrons are ob-

tained by the $Li^7(d,n)Be^8$ reaction using 2 Mev deuterons. Experimental apparatus is described and typical results are discussed. (J.R.D.)

27732 (HW-73116(p.51-63)) TOTAL NEUTRON CROSS SECTIONS OF LITHIUM, SODIUM, POTASSIUM, ALUMINUM, IRON, AND COPPER BETWEEN 3 AND 15 Mev. D. W. Glasgow and D. G. Foster, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The technique for measuring total neutron cross sections at 3 to 15 Mev, in which an intense source of neutrons having a continuous spectrum of energies is used, was tested by measuring the cross sections for Li, Na, K, Al, Fe, and Cu. Results are presented graphically. The results for the alkali metals could not be satisfactorily compared with earlier data. The results on Al are in good agreement with previous data. Agreement becomes worse in either direction from Al. Plans for further measurements are outlined. (J.R.D.)

27733 (HW-73116(p.64-70)) LATTICE PARAMETER MEASUREMENTS FOR A 1.66-INCH URANIUM ROD IN A 6.5-INCH GRAPHITE LATTICE. D. E. Wood and K. R. Birney (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The analysis of buckling measurements in graphite-uranium systems requires, among other things, the knowledge of the 1/v utilization, $f_{1/v}$. Measurements of f in the Physical Constants Test Reactor (PCTR) are available for only a few of the lattices studied in exponential experiments. Thus utilizations have been calculated by the P_3 method with an empirical adjustment to the spectrum-averaged cross sections. The adjustment was made by comparison of calculated-to-measured flux traverses. Since the available traverses did not cover the complete range of C-to-U ratios used in the exponential experiments, a measurement was needed for a lattice with a low C-to-U ratio. A measurement for a large C-to-U ratio was not needed since the cross-section adjustment was small and easily extrapolated from the available data. The experimental configuration chosen was a 1.66-inch natural U fuel rod in an air-cooled, 6.5-inch graphite lattice. Measurements of k_∞ and $f_{1/v}$ were supplemented by Lu activations to determine the spectral index at three positions in the lattice cell. The values of k_∞ and f are 0.943 ± 0.003 and 0.959 ± 0.002, respectively. The effective neutron temperatures were 139°C at the fuel center, 109°C at the fuel surface, and 65°C at the cell edge. The flux distribution was fitted with a P_3 calculation in which the graphite cross section was reduced by a factor of 0.77 to correct for the epithermal flux effect and the moderator neutron temperature increase. The fuel cross section was further reduced by a factor of 0.927 to correct for spectral hardening in the fuel. The epithermal flux effect arises because the experimental traverses include neutrons of all energies weighted by a 1/v activation cross section. However, the P_3 calculation is monoenergetic so that an empirical adjustment is needed to get agreement between theory and experiment. A multigroup calculation would require less adjustment, but the one-group method is chosen for simplicity. (auth)

27734 (HW-73116(p.71-81)) THE FUEL TEMPERATURE COEFFICIENT OF K_∞ FOR PLUTONIUM–ALUMINUM FUEL. R. I. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The change in the reactivity of the Physical Constants Testing Reactor (PCTR) was measured as a section of Pu-Al fuel rods in the center test cell of the core was heated from room temperature to more than 400°C. Measurements were made with 1.88 wt % low exposure Pu-Al, with 2.07 wt % high exposure Pu-Al, and with dummy Al rods in the test cell. The signs and the magnitudes of the fuel temperature coefficients of k_∞ were obtained from the data. The effects of heating the fuel on the neutron multiplication of the lattice cells fueled with Pu-Al were found to be small in magnitude and negative in sign. The magnitude of the negative effect was seen to be a function of the concentration of Pu^{240} in the fuel. The higher Pu^{240} density material yielded a larger negative effect. The results indicate that for Pu-Al fuels of low Pu density, i.e. ~2 wt % Pu in Al, the major contributor to the fuel temperature coefficient is the Doppler effect in Pu^{240}. (auth)

27735 (HW-73116(p.82-92)) EXPERIMENTAL STUDIES IN LOW EXPOSURE Pu–Al LATTICES. R. I. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Experiments were conducted in the PCTR on reactor lattices fueled with 19-rod clusters of 0.5-in. diameter rods of low exposure Pu-Al. The lattices were graphite moderated and air cooled. Measurements were made for lattice spacings of 6.500, 8.375, and 10.500 in., all with a square pitch. The mass of Cu required to poison each lattice to unit multiplication was determined. Foil activation data were obtained at various positions throughout the lattices with Au, Cu, Lu, U^{235}-Al, and Pu-Al, and Pu-Al detectors. Ratios of fission rates of Pu^{239} and U^{235} in the lattice spectra were measured relative to the ratio of the same fission rates in a Maxwellian spectrum. The information is presented in graphic and tabular form. (auth)

27736 (HW-73116(p.93-5)) AN INVESTIGATION OF THE EFFECTIVE NEUTRON TEMPERATURES IN Pu–Al LATTICES. R. I. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.

An attempt was made to determine the effective neutron temperatures from activation data obtained in Pu-Al lattices. The data used were those given in a previous report. The analysis did not prove to be satisfactory. If it is assumed that the Westcott model satisfactorily represents the neutron energy distribution in a reactor lattice, then the effective temperature of the Maxwellian portion of that distribution can be inferred from foil activation data. The two parameter model of Westcott is not sufficient to describe the spectrum in a reactor lattice of this type fueled with Pu. Even in the cases in which it was possible to infer an effective temperature, the results were strongly dependent upon the choice of a joining function. The results became progressively worse as the fuel to moderator ratio was increased. (auth)

27737 (HW-73116(p.96-100)) SPECTRAL MATCHING IN THE PCTR BY REACTIVITY MEASUREMENTS. J. B. Worden (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Measurement of the infinite multiplication factor, k_∞, of a given reactor lattice can be accomplished in the Physical Constants Testing Reactor if the neutron spectrum within the test lattice is similar to the spectrum that would exist in an infinite array of the test cells. The spectrum in the test lattice can be adjusted by varying the type and quantity of fuel in the PCTR outside the test region. The criterion that was used to determine when the spectrum was matched is equality of Cd ratios measured at corresponding points in the central cells and one of the buffer cells. An alternate method is presented that relies solely on reactivity measurements. The condition for a spectral match is that the implied mass of poison required to poison the cell to a k_∞ of unity be the same at the central cell and at a buffer cell. The plausibility of this statement is demonstrated by means of a two-group model of a homogeneous core. (auth)

27738 (HW-73116(p.101-7)) CRITICAL MASS EXPERIMENTS WITH PLUTONIUM NITRATE SOLUTIONS. R. C. Lloyd, E. D. Clayton, and W. A. Reardon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Critical mass studies were made of plutonium nitrate solutions in a 14-in. dia stainless steel sphere. The Pu concentrations ranged from 30 to 231 g/l with acid molarities varying from 1.1 to 5.6 molar. The wall thickness of the spherical vessel is 0.044 in. Measurements were made with the vessel bare and reflected with ½ in. of paraffin, 1 in. of paraffin, 4 in. of concrete, and 10 in. of concrete. Four measurements were made with the sphere covered with 0.030-in. Cd sheet backed with reflector. Evaluations were made of the control rod worth at various concentrations. The data from the experiments are summarized. The additional experiments with paraffin reflectors were used to obtain improved estimates of the reflector savings of this material. Estimates for the reflector savings of the various reflectors were obtained by first correcting the critical volumes of the bare spheres for the effect of the stainless steel shell by 14 ml/mil of stainless steel; then by comparing equivalent spherical radii, a reflector savings for the vessel wall and added reflector could be calculated from the measured volumes. The equivalent sphere volume for those cases in which the vessel was subcritical when full was taken as the extrapolated critical volume; the equivalent sphere radius for a partially filled sphere was estimated on the basis of equal surface-to-volume ratios for equivalent systems. These reflector savings are given for three concentrations of Pu. Control rod worth was evaluated during the critical approaches by means of multiplication measurements. The control rod consists of a stainless steel tube which is 1 in. in OD with a 0.065-in. thick wall; this tube can be inserted directly into the solution to within about 2 in. of the sphere bottom. A plot of control rod worth versus Pu concentration is included. The worth varies from about 60 ml of solution at high concentrations to about 560 ml at low concentrations. The control rod worth in terms of Pu appears to have a nearly constant value of about 15 grams over the entire range of concentrations measured, essentially independent of the H: Pu ratio. (auth)

27739 (HW-73116(p.108-20)) LIMITING CRITICAL CONCENTRATIONS FOR A PLUTONIUM NITRATE SOLUTION AND FOR A URANIUM-235 SOLUTION. R. H. Masterson, V. I. Neely, and T. J. Powell (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Experiments were conducted to determine the limiting concentration (the concentration for which k_∞ = unity) of aqueous plutonium nitrate and uranyl fluoride solutions. For the Pu experiment, the solutions were contained in stainless steel tanks. Because of the difficulty in evaluating the effect of the stainless steel on the measurements, the uncertainty in the measured limiting concentration is approximately ±1 g/l. The experimental data were corrected for the effects of the Pu^{240}, Pu^{241}, and nitrate present to give a value of 8.4 ± 1 g/l as the limiting concentration for Pu^{239} in an aqueous solution. Foil irradiations were made using Au, Cu, and Pu^{239} foils. Cd ratios of 4.83 for the Au and 14.89 for the Cu were obtained. The results of the Pu-U foil irradiations indicate an effective neutron temperature of about 390°K, whereas the physical temperature of the solution was 299°K. The 93% enriched UO_2F_2 measurement was made using containers of Al, which had no measurable effect on the results. The experimental data give a value of 12.94 ± 0.03 grams of U/l (12.05 ± 0.03 g/U^{235}/l) as the limiting concentration of the solution used in the measurement. Au foil irradiations gave a Cd ratio of 9.6 in the center of the system. (auth)

27740 (MND-P-2761) FINAL SAFETY EVALUATION OF A TEN WATT STRONTIUM-90 FUELED GENERATOR FOR A DEEP SEA APPLICATION–SNAP 7E. H. N. Berkow and V. G. Kelly (Martin Co. Nuclear Div., Baltimore). May 1962. Contract [AT(30-1)2958]. 51p.

A safety evaluation of the SNAP 7E thermoelectric generator system is described. Analyses were performed to assess the radiobiological effects in event of a fuel release and the shielding was evaluated to determine the safe working limits for personnel. The entire evaluation is based on a fuel loading of 31,000 curies of radiostrontium. It is concluded that the safety criteria are met and there is reasonable assurance that this generator is safe for its intended mission. (J.R.D.)

27741 (NP-11716) LIGHTWEIGHT, EXTREMELY HIGH-POWER ELECTRICAL SOURCES. Donald A. DeMoulin and John H. Granger (Army Signal Missile Support Agency, White Sands Missile Range, N. Mex.). May 5, 1962. 33p. (MEWD-1129)

The characteristics and present state-of-the-art of producing large blocks of electrical power for short duration are reported for lightweight power sources. The following sources are considered: batteries, turbine-driven electromagnetic a-c and d-c generators, thermionic converters, thermoelectric generators, magnetohydrodynamic generators, fuel cells, and electrostatic generators. Particular emphasis is placed on the sizes and weights of the sources per unit of power produced. At present it appears that the silver zinc battery is the least complex and most reliable lightweight, high power d-c output device for short duration runs up to five or ten minutes. If a-c is desired, either solid or liquid fuel turbo-generators are desirable. Turbine generators are best suited for producing power on a long-term basis. (N.W.R)

27742 (NP-11983) TABLES OF DRIFT VELOCITIES OF SLOW ELECTRONS IN HELIUM, NEON, ARGON, KRYPTON, XENON, HYDROGEN, DEUTERIUM, NITROGEN, CARBON MONOXIDE, CARBON DIOXIDE, WATER VAPOR, NITROUS OXIDE, AND AMMONIA. Technical Report No. 13. J. L. Pack, R. E. Voshall, and A. V. Phelps (Westinghouse Electric Corp. Research Labs., Pittsburgh). July 23, 1962. Contract NONR 2584(00). 22p.

Drift velocities of electrons in various gases are tabulated. The drift velocities were measured in He, Ne, Ar, Kr, Xe, H, D, N, CO, CO_2, water vapor, N_2O, and NH_3 for E/p values from 10^{-4} to 30 volts/cm-mm Hg at several gas temperatures between 77 and 443°K. In all gases except Ne, measurements were extended to low enough E/p such that the electrons were in thermal equilibrium with the gas. (auth)

27743 (NYO-9700) DEVELOPMENT TECHNIQUES FOR POWER PRODUCTION FROM MIXED FISSION PRODUCTS. Phase II Mid-Term Report. E. J. Lemanski (General Instrument Corp. Thermoelectric Div., Newark, N. J.). May 21, 1962. Contract AT(30-1)-2605. 109p.

Progress is reported on Phase II of a program for the development of a mixed fission product fueled thermoelectric generator. Results of the Phase I investigations and analyses were extended into areas requiring technological development, namely, consolidation and encapsulation techniques of synthetic ICPP fuel wastes, and thermoelectric materials assembly techniques. Results of fuel consolidation developments are described whereby calcined wastes, nominally 1 g/cc, were densified via various milling, compacting, fluxing and sintering methods to yield material of up to 2.6 g/cc. A container for encapsulating the MFP waste

material into a fuel source suitable for an undersea thermoelectric generator was designed. The analytical design of a 3 watt (electrical) undersea thermoelectric generator was completed. Without shielding, the generator package would be contained in a 40-inch diameter sphere. An eight-inch lead shield would limit the dose level to 10 mr/hr at 3 feet from the fuel centerline. Materials studies are described in which bonded assemblies of bismuth telluride were life tested up to 3000 hours at 350 to 400°F hot junction temperature. Data were too inconsistent to define any satisfactory long-life bonding process. Further work is needed to eliminate the process variables. Insulation studies aimed at determining the thermal conductivity of various insulations with different fill gases under reduced pressures are described. Opacified aerogel powder appears to be very promising as an insulation medium for a diffuse heat source. A full-scale simulated test generator aimed at proving out the concept of a diffuse heat source for power generation is described. Progress on the construction of this electrically heated generator and its thermoelectric power converter is related. (auth)

27744 (NYO-9701) ECONOMIC FACTORS OF MFP THERMOELECTRIC GENERATORS. Interim Report. M. Barmat (General Instrument Corp. Thermoelectric Div., Newark, N. J.). [June 8, 1962]. Contract AT(30-1)-2605. 35p.

Mixed Fission Products (MFP) for use as a heat source for thermoelectric generators will become increasingly available in the coming years. The Atomic Energy Commission sponsored program on solidification of nuclear wastes is now entering the hot-bench scale test phase. During this phase approximately 5000 thermal watts of two year old MFP could be produced monthly. Two different types of hot calcination pilot plants are planned for installation at the Hanford National Laboratories in the 1964 to 1966 time period. Each of these plants should be able to produce 160,000 thermal watts of two year MFP and 16,000 thermal watts of ten year MFP on a monthly basis. During this phase, MFP costs should be less than $0.15 per thermal watt for two year MFP and $1.50 for ten year MFP. This cost includes operation of the plant solely to obtain heat sources and sealing the MFP into fuel containers. A full scale plant for a 15,000 Mw(e) nuclear economy is estimated to produce four to five times as much MFP as either of the pilot plants. Costs will be dependent upon AEC policy in effect at the time the plant is operating. If the policy indicates that the full cost be paid by the user, the prices will approximate that obtained from the pilot plant operation. A conceptual design has been made for MFP fueled generators at several output power levels up to 1000 watts. These are for use at great underwater depths and contain an integral biological shield. A low cost biological shield of high density concrete or cast iron is considered. Economic studies indicate that, in production quantities, a 10 watt generator will cost one tenth an equivalent Strontium-90 generator. Because of the low cost for MFP heat sources, radionuclide generators at the hundred and thousand watt level can be reasonably postulated for the first time. At the kilowatt level costs of $5 per watt year are achievable while $50 to $100 are estimated at the ten watt level. Currently available ocean-going craft can handle the placement of MFP generators up to the hundreds of watts level. Investigation of other available vessels is continuing. (auth)

27745 (AEC-tr-5288) STUDY OF SPECTRA PRODUCED BY HIGH-FREQUENCY ELECTRIC DISCHARGE IN GASES AND FLAMES AT ATMOSPHERIC PRESSURE. V. S. Rossikhin and T. S. Tsikora. Translated by Alma Bekelman (Ames Lab., Ames, Iowa) from Zhur. Fiz. Khim., 29: 1079-86(1955). 19p.

This paper was previously abstracted from a French translation (CEA-tr-R-1072) and appears in NSA, Vol. 15, abstract no. 11791.

27746 (FTD-TT-62-12) THE DIRECT CONVERSION OF THERMAL INTO ELECTRICAL ENERGY. I. K. Vul'fel'dt. Translated from U.S.S.R. Patent No. 141560, Dec. 15, 1960. 4p.

Two methods for the direct conversion of thermal energy into electric energy are discussed. The known method for the direct conversion consists of alternately heating and cooling the ferromagnetic core of a nonlinear induction coil of a thermoelectric generator approximately to the Curie point to excite the alternating current resulting from the periodic change in the permeability of the core-material. The method proposed differs in that a nonlinear inductance coil is connected with a line capacitor in the circuit which operates under conditions of parametric resonance at a frequency half that of the core-heating frequency. This method permits a decrease in weight, dimensions, and inertia of the thermoelectric generator. A diagram gives the main aspects of the conversion device and clarifies the method employed. (N.W.R.)

27747 (JPRS-14515) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS MINISTRY OF HIGHER AND SECONDARY SPECIALIZED EDUCATION USSR RADIOPHYSICS SERIES. Translation of Izvestiya Vysshikh Uchebnykh Zavednii, Radiofizika, 5: No. 1, 1-204(1962). 458p.

A translation of the Russian-language journal Izvestiya Vysshikh Uchebnykh Zavedenii Mvi SSO SSR, Radiofizike, Vol. 5, No. 1, 1962 is presented. Separate abstracts were prepared for 9 of the 31 papers. (M.C.G.)

27748 (JPRS-14515(p.20-37)) EFFECT OF IRREGULARITIES IN THE ELECTRON CONCENTRATION OF THE IONOSPHERE ON MEASUREMENTS OF SOME OF ITS PARAMETERS. Yu. A. Ryzhov and O. I. Yudin. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 5: 13-20(1962).

A method is proposed for measuring the electron concentration, with the aid of artificial earth satellites, based on measuring the phase invariant of a triharmonic wave. The effects of the diffraction of radio waves by the ionospheric irregularities of the fluctuations of the phase invariant were considered. The fluctuations of the reduced differences of the Doppler frequencies due to defraction on random inhomogeneities of the electron concentration are discussed. The accuracy of measurements by this method is estimated. (M.C.G.)

27749 (JPRS-14515(p.96-123)) PENETRATION OF AN ELECTROMAGNETIC FIELD IN A MAGNETOACTIVE PLASMA. E. A. Kaner and Yu. A. Belov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 5: No. 1, (1962).

The propagation of ordinary and extraordinary waves transverse to an external magnetic field in a semi-bounded plasma was investigated in the kinetic approximation taking into account ion motion. The distribution functions of the particles were found for diffused reflection of the electrons and ions from the plasma surface. The singularities of surface absorption were investigated. The effective depths of penetration of the electric and magnetic fields were calculated for the limiting cases of weak and strong spatial dispersion. Particular attention was paid to resonant properties of the plasma at the hybrid frequency $\sqrt{\Omega_e \Omega_i}$ and also in the regions of the electronic and ionic gyrofrequencies Ω_e and Ω_i. (auth)

27750 (JPRS-14515(p.124-42)) CONTRIBUTION TO THE THEORY OF ELECTROMAGNETIC FLUCTUATIONS IN A PLASMA. V. F. Aleksin and K. N. Stepanov. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 5: No. 1, (1962).

Correlation functions were derived for the electric and magnetic fields in a plasma situated in an external magnetic field. In the isotopic case, an investigation was made of the asymptotic behavior of the correlation functions for the fields at large and small distances, and the motion of a charged particle under the influence of the fluctuation field was also considered. (auth)

27751 (JPRS-14515(p.201-19)) DISTORTION OF THE NUCLEAR QUADRUPOLE RESONANCE LINE SHAPE DUE TO APPARATUS FACTORS. V. S. Grechishkin and I. A. Kyuntsel'. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 5: No. 1, (1962).

It is shown by numerical calculations of intensity and the shape of the signal of absorption lines, described by Gauss and Lorentz functions, that when the frequency modulation amplitude is on the order of half the line width, it becomes meaningful to record the third harmonic of the signal. Records of different derivatives of the absorption lines are presented. It is shown that the time constant of the phase detector influences the position of the center of the line in recording various derivatives. (auth)

27752 (JPRS-14515(p.220-45)) REACTION OF RECEIVING CIRCUIT IN EXPERIMENTS ON FREE NUCLEAR INDUCTION IN WEAK MAGNETIC FIELDS. F. I. Skripov and E. L. Al'tman. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 5: No. 1, (1962).

The effect of the reaction of a receiving circuit on the envelope and on the frequency of the signal of free nuclear induction in a weak magnetic field was investigated. For the case of identical longitudinal (T_1) and transverse (T_2) relaxation times, exact analytic expressions were obtained, and the general case was investigated by numerical means using a computer. It was found that the analytic expressions are approximately applicable also when $T_1 \neq T_2$. The response of a receiving circuit in the presence of multiplet structure of the nuclear resonance signal was also considered. (auth)

27753 (JPRS-14515(p.259-71)) REACTION OF RADIATION OF A MOVING CHARGE IN A WAVEGUIDE FILLED WITH ANISOTROPIC DIELECTRIC. Yu. S. Korobkov and V. Ya. Eydman. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 5: No. 1, (1962).

The reaction of the radiation of a charge moving in a rectangular waveguide filled with an anisotropic dielectric was considered. It is shown that because of the radiation reaction, oscillations of the particle can build up in this case. (auth)

27754 (JPRS-14515(p.365-72)) ORIGIN OF COSMIC RADIO EMISSION AND COSMIC RAYS. G. G. Getmantsev. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 5: No. 1, (1962).

The nature of primary cosmic rays and the origin of cosmic radio emission are discussed. The discrepancy between the spectra of the radio emission from sources of cosmic rays and the halo was considered evidence that the cosmic rays in the halo are not connected kinetically with the supernovae. The fact that spectrum of radio emission of the plane subsystem is somewhat less steep than that of the halo was considered proof that exchange of cosmic rays between the flat subsystem and the halo is difficult. Motion of cosmic rays is discussed. (M.C.G.)

27755 (JPRS-14515(p.373-8)) ENERGY LOSSES OF A PARTICLE MOVING OVER AN IDEAL CONDUCTING STATISTICALLY ROUGH SURFACE. F. G. Bass and S. I. Khankina. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 5: No. 1, (1962).

The energy losses per unit length by a particle moving along the x_1 axis were determined by the equation $dw/dx_1 = qE_1$. In the case of a statistically uneven separation boundary, the electromagnetic field above the boundary consists of an average and fluctuating components which go to make up E_1. Equations were derived for determining the spectral density of the energy losses per unit frequency interval. (M.C.G.)

27756 (JPRS-14515(p.379-85)) PROPAGATION OF ASYMMETRICAL ELECTROMAGNETIC WAVES IN A PLASMA ROD AND THEIR RADIATION. V. P. Shestopalov, I. P. Yakimenko, and V. D. Fil'. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiofiz., 5: No. 1, (1962).

The propagation of asymmetrical waves in a plasma rod with longitudinal magnetic field was investigated under the most general assumptions. It was found that the phase velocity of waves of different types depends greatly both on the frequency and on the parameters of the medium and on the magnetic field which is applied along the axis of the plasma rod. An approximate calculation of the directivity pattern was made with the aid of the Huyghens-Kirchhoff principle. It was concluded that the directivity patterns of the plasma rod are symmetrical about the axis. Therefore variation of the magnetic field causes the maximum of the radiation to shift relative to the axis. (M.C.G.)

27757 THE FIELD METHOD OF OBTAINING THE CONSERVATION LAWS AND THE LAGRANGIAN. Marek Demiański and Eryk Infeld (Univ. of Warsaw). Acta Phys. Polon., 11: 469-479(1962). (In English)

The conservation laws are derived directly from the field equations. From these laws the Lagrangian is obtained, thus leading to the equations of motion. (auth)

27758 ISOTOPE SHIFTS IN THE Cd II LINES λ 3235 Å AND λ 3250 Å. Z. Leś and F. Leś (Jagellonian Univ., Cracow, Poland). Acta Phys. Polon., 21: 429-31(Apr. 1962). (In English)

The shifts were observed using a Fabry-Perot interferometer having multi-layer dielectric mirrors. Improved luminosity and resolving power were obtained. Cadmium of natural isotopic abundance was used, and the spectral lines revealed a highly involved structure. Only the positions of the three most intense components emitted by Cd^{110}, Cd^{112}, and Cd^{114} were determined. Data are presented in graphical and tabular forms. (L.N.N.)

27759 SPECIFIC HEAT OF TANTALUM AND TIN NEAR THE SUPERCONDUCTING CRITICAL TEMPERATURE. John F. Cochran (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 19: 186-218(Aug. 1962).

An unsuccessful search has been made for a λ-type of singularity in the specific heats of tantalum and tin. For these two metals an upper limit of 1-millijoule/mole/°K has been established for the entropy associated with such a singularity. In the analysis of the data it was found convenient to introduce a model for which it is supposed that a superconductor can be considered as an aggregate of many small, homogeneous volume elements. Each small-volume element is characterized by a critical temperature, T_θ, and the temperatures T_θ are assumed to be distributed around a mean temperature T_c. The fraction of the total volume of a specimen having critical temperature T_θ is taken to be $N(T_\theta) = (1/\Delta\sqrt{\pi}) \exp[-(T_c - T_\theta)^2/\Delta^2]$, where Δ

is a measure of the temperature interval over which the transition takes place. For tin of high purity it appears that Δ is a linear function of resistance at 4.2°K, with $d\Delta/d\rho = +3.6°K/\mu ohm\ cm$. (auth)

27760 MOTION OF FOREIGN BODIES IN BOSON SYSTEMS. E. P. Gross (Brandeis Univ., Waltham, Mass.). Ann. Phys. (N. Y.), 19: 234-53(Aug. 1962).

The system studied is a foreign particle interacting with a gas of bosons. Particular attention is paid to the case of a foreign ion coupled to the atoms by a hard core potential plus a long range polarization potential. The essential features of the problem appear in a self-consistent field approximation. A finite fraction of the atoms is in a single particle state which is spatially inhomogeneous relative to the ion and forms a condensate. There is an enhanced density of bosons near the ion. The velocity flow pattern is such that the ion pushes fluid away directly ahead of itself, but there is a reversed dipolar flow far from the ion. The effective mass is very high; it is greater than the number of atoms contained in a volume $\frac{4}{3}\pi b^3$. The parameter b is the distance where the polarization energy becomes comparable to the boson-boson interaction energy. An outline is given of a systematic theory which includes corrections to the above-mentioned results arising from the zero-point energy shift of the oscillations of the coupled ion-boson system. (auth)

27761 ELECTRON HEATING IN MAGNETOHYDRODYNAMIC POWER GENERATORS. H. Hurwitz, Jr., G. W. Sutton, and S. Tamor (General Electric Co., Philadelphia). ARS (Am. Rocket Soc.) J., 32: 1237-43(Aug. 1962).

Electron heating arising from the induced electric field is theoretically analyzed in three different idealized direct-current MHD generator geometries. It is shown that the electron temperature can be considerably higher than the initial stagnation temperature of the gas. For conditions of electron heating, the current, electrical conductivity, and power density are calculated in a mixture of argon and 1% potassium in a segmented-electrode geometry. The calculated electrical conductivities and power densities are higher by one to two orders of magnitude than those achieved in MHD generators using combustion gases, but at a much lower temperature. These results indicate a possible method of solving two of the major problems of MHD power generation, viz., electrical conductivity and gas temperature. (auth)

27762 ELLIPTICAL WAVEGUIDE. Piergiorgio Uslenghi. Atti accad. sci. Torino. I. Classe sci. fis., mat. e nat., 95: 713-65(1960-61). (In Spanish)

The propagation of electromagnetic waves in a coaxial elliptical waveguide is studied by examining the various possible modes of propagation. Diverse guide structures which can be obtained by the introduction of electrical walls and other similar containments are analyzed. (tr-auth)

27763 MAGNETODYNAMIC OSCILLATIONS IN AN ELECTRICALLY CONDUCTING GASEOUS ATMOSPHERE EXPOSED TO GRAVITATIONAL ACTION. Jacopa Vacca. Atti accad. sci. Torino. I. Classe sci. fis., mat. e nat., 95: 865-76(1960-61). (In Spanish)

Magnetohydrodynamic oscillations at the center of an equilibrium configuration in an electrically conducting isothermal perfect gaseous layer in motion, exposed to gravitational action and immersed in a constant magnetic field perpendicular to the layer, were studied. In the first approximation such a gaseous layer can be considered as representing the atmosphere of a spherical star with large radius. The case in which the unknown quantities depend only on the ratio and on time is considered. The determination of the oscillations of the magnetic field and of the velocity can be reduced to the resolution of two integral equations; the other unknown can be determined by means of numerical quadrature. (tr-auth)

27764 MAGNETODYNAMIC EQUILIBRIUM OF A SPHERICAL GRAVITATING GASEOUS MASS IN NON-UNIFORM ROTATION. Giorgio Ferrero. Atti accad. sci. Torino. I. Classe sci. fis., mat. e nat., 95: 877-86(1960-61). (In Spanish)

A fluid gaseous mass, highly electrically conducting, in non-uniform rotation, symmetrical with respect to the axis of rotation, exposed to self gravitation and to an axial magnetic field is considered. It is assumed that for small variation of the magnetic field the mass is only slightly removed from the spherical form. The equilibrium configuration determining the intensity of the magnetic field and the surface limiting the fluid mass is studied under the hypothesis that because of the above assumption the density is negated. (tr-auth)

27765 ATOMIC FREQUENCY STANDARDS USING OPTICAL PUMPING OF RUBIDIUM-87 AND CAESIUM-133 IN GAS CELLS. V. B. Gerard (National Physical Lab., Teddington, Middx., Eng.). Brit. J. Appl. Phys., 13: 409-14(Aug. 1962).

The more important variables involved in the engineering of practical gas cell frequency standards are measured. Particular emphasis is laid on the importance of the frequency shifts produced by buffer gas pressure and temperature, and incident light intensity. It is shown that stabilities of one or two parts in 10^{11} should be possible, and this figure is approached with a laboratory standard. (auth)

27766 ON A TWO-DIMENSIONAL COMPRESSIBLE JET IN MAGNETOHYDRODYNAMICS. M. Z. v. Krzywoblocki (Michigan State Univ., East Lansing). Bul. inst. politeh. Iasi, 7: 59-96(1961). (In English)

The subsonic flow of an electrically conducting fluid from a very large reservoir in the presence of electric and magnetic fields is studied. An attempt is made to use the Chaplygin hodograph method, which involves coordinate transformations linearizing the stream function equations, but not affecting the linearity of the electromagnetic equations. The complicating feature of magnetohydrodynamics is that a large system of equations must be dealt with. Also the addition of electromagnetic equations cause a general system to be overspecified. An attempt is made to solve a specific example by an iteration process based on Chaplygin's solution to the jet problem in ordinary gas dynamics. In conjunction with this iteration a thorough discussion of the boundary conditions is given. The complete procedure for the transformation of the solution back to the physical plane is outlined. (J.S.R.)

27767 AN APPARATUS FOR THE STUDY OF SHORT-LIVED FISSION PRODUCT RARE GASES. D. W. Ockenden and R. H. Tomlinson (McMaster Univ., Hamilton, Ont.). Can. J. Chem., 40: 1594-1604(Aug. 1962).

A procedure is described for the isolation, separation, and study of short-lived krypton and xenon isotopes formed by thermal fission of uranium. The gases are swept out from a thin film of U^{235} stearate, rapidly separated by gas chromatography, and examined by gamma-spectrometric techniques. Krypton isotopes have been studied within 10 seconds of their formation in the reactor and xenon isotopes within 25 seconds. Spectra are reported for krypton-89 and -90, xenon-137, -138, and -139. (auth)

27768 THE RANGE OF Cs^{137} IONS OF Kev ENERGIES IN GERMANIUM. J. A. Davies, J. D. McIntyre, and G. Sims (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem., 40: 1605-10(Aug. 1962). (AECL-1538)

The range of Cs^{137} ions in germanium has been measured at 4-, 20-, and 40-kev bombardment energy. Two independent methods of determining the depth of penetration were used. The results are in reasonable agreement with our previous range measurements in aluminum, and with the recently published theoretical treatment of Lindhard and Scharff. A possible explanation has been found for the abnormally large value reported by Bredov for the penetration depth of 4-kev Cs^{134} ions in germanium. (auth)

27769 THE EFFECT OF WINDS ON THE GRAVITY WAVE. V. H. Weston and D. B. Van Hulsteyn (Univ. of Michigan, Ann Arbor). Can. J. Phys., 40: 797-804(July 1962).

The effect of wind upon the gravity waves produced by a large explosion is considered. The uniform horizontal wind is applied to the hydrodynamic equations; application of perturbation techniques results in an equation for excess pressure, which involves the wind velocity. In the limiting case, as this velocity approaches zero, this equation becomes identical with the non-wind case. This equation is solved by numerical methods with appropriate boundary conditions for the particular model of the atmosphere considered. For a pulse traveling down-wind, the effect of the wind is to increase the dispersion and the phase velocity in the gravity wave mode. (auth)

27770 RYDBERG ABSORPTION SERIES OF CO_2 CONVERGING TO THE $^2\Pi_u$ STATE OF CO_2^+. Y. Tanaka and M. Ogawa Air Force Cambridge Research Labs., Bedford, Mass.). Can. J. Phys., 40: 879-86(July 1962).

The absorption spectrum of CO_2 is investigated in the region 670 to 790 Å with a 6.8-meter grazing-incidence-type vacuum spectrograph. The Henning Rydberg series is measured accurately along with its $v' = 1$ vibration series. In this manner, the ionization energy of the $2\sigma_u$ electron is determined to be 18.076 ev. Sixteen other Rydberg series are observed in this region. It is concluded that they are formed by the excitation of the $1\pi_u$ electron. The ionization potentials corresponding to the energies of the $^2\Pi_{u\frac{1}{2}}$ and $^2\Pi_{u\frac{3}{2}}$ states of CO_2^+ are found to be 17.312 and 17.323 ev respectively. (auth)

27771 THE SPEED OF PROPAGATION OF A SHOCK ENGENDERED BY MAGNETODYNAMIC PULSE. Charles H. Faulders (Universite, Marseille). Compt. rend., 254: 3688-2(May 14, 1962). (In French)

In the shock tube the discharge of a condenser occurs at very high temperature and ionizes the gas in the chamber; this gaseous mass is propelled at high velocity toward the tube under the action of the magnetic field created by the discharge current. An intense shock is thus produced which ionizes the gas in the tube. The velocity of the shock can be calculated approximately as a function of the distance traveled and of the total energy accumulated in the condenser under the hypothesis that the conductivity of the plasma downstream of the shock is infinite. It is then assumed that the magnetic field acts as a piston being displaced longitudinally without penetrating the gas. The calculated results were compared with experimental results and satisfactory agreement was found. (J.S.R.)

27772 THE ANALOGY OF THE TAYLOR-PROUDMAN THEOREM IN MAGNETOHYDRODYNAMICS. John Carstoiu (Science for Industry, Inc., Brookline, Mass.). Compt. rend., 254: 3493-5(May 14, 1962). (In French)

The analogy that exists between the Taylor-Proudman theorem for a fluid in uniform rotary motion and the slow and permanent motion of a conducting fluid in the presence of a uniform magnetic field has been noted. It was observed that the Taylor-Proudman theorem is only one consequence of the equation ruling the vortex in a reference system driven by uniform rotation. The possible generality of this problem in the case of magnetohydrodynamics is briefly defined. (J.S.R.)

27773 EFFECT OF THE IONIZATION DENSITY ON THE LUMINOUS YIELD OF LIQUID SCINTILLATORS (α/β ratio). Francis Urban, Gilbert Laustrait, and Andre Coche (Centre de Recherches Nucléaires, Strasbourg). Compt. rend., 254: 3523-5(May 14, 1962). (In French)

The effect of liquid solution composition, oxygen, and temperature on the α/β ratio was studied on liquid scintillators. (tr-auth)

27774 SLOWING DOWN OF α PARTICLES OF THORIUM C AND THORIUM C′ BY GOLD SCREENS. Jeannine Blandin-Vial (Centre National de la Recherche Scientifique, Orsay, France). Compt. rend., 254: 3842-4 (May 28, 1962). (In French)

The slowing down of α particles of ThC and ThC′ by very fine gold screens was studied. The values found were used to calculate the mean ionization potential I of gold and to compare this value with those deduced from the works of other authors. (tr-auth)

27775 THE INTENSITY OF THE γ RADIATION EMITTED BY A SPHERICAL, HOMOGENEOUS, AND SELF-ABSORBING RADIOACTIVE SOURCE. Claude Kellershohn and Bernard Herszberg (Faculté de Médecine, Paris). Compt. rend., 254: 4015-17(June 4, 1962). (In French)

The self-absorption of the γ radiation in a spherical homogeneous and self-absorbing radioactive source is expressed exactly by means of elementary algorithms as a function of the product of the linear absorption coefficient and of the source diameter. The diverse approximation given by different authors is deduced from the exact expression proposed. (tr-auth)

27776 THE DIFFERENTIAL EQUATIONS OF MAGNETOHYDRODYNAMICS. David E. Edmunds. Compt. rend., 254: 4248-50(June 18, 1962). (In French)

The existence of weak solutions of magnetohydrodynamic equations in the third dimension is shown. (tr-auth)

27777 STUDIES WITH FAST ATOMIC BEAMS OF HELIUM. Joseph Lipsig (Brooklyn Polytechnic Inst.). Dissertation Abstr., 22: 1026-7(Oct. 1961).

An apparatus is constructed to produce a high-energy atomic beam (500 to 2,000 ev) and to study the interaction of this beam with gases and surfaces. The beam source consists of an arc section where the beam is formed, and a scattering section where experiments are performed with the beam. The arc section contains a filament that produces electrons, an anode that accelerates them, a cathode that extracts the ions produced by the accelerated electrons, and an atom gun that accelerates the ions to the desired energy. On passing through the atom gun many ions are neutralized to fast atoms of the same energy by the process of charge exchange and this beam of atoms and ions is converted to a pure atomic beam by deflecting plates that remove the residual ions. Helium gas is used in these experiments. Although the apparatus is designed to produce a homogeneous beam of atoms, the possibility exists that such is not the case. Calculations based on charge exchange experiments indicate that only a small fraction of the beam particles are ions and that the translational energies are not uniform. An investi-

gation is undertaken of the intensity of the beam. Using an approximate value for the electron ejection ability of the fast helium atoms, it is concluded that the fast helium beam has an intensity of 2.5×10^{11} particles per second. This value is comparable to that which can be estimated with a thermocouple detector. It also appears that the intensity of the beam is greater when the arc is operated with the anode shorted to the cathode under the particular conditions used. A study is made of the interaction of the helium beam with a copper surface. It is found that electrons and ions (or metastable atoms) are produced in this interaction. Evidence is presented that this production of ions is similar to the reflection of ions when ionic beams strike a surface. Various possible physical mechanisms responsible for the production of ions are discussed. It is not believed that these particles are ionized by massive collisions at the surface by beam particles striking the surface atoms, nor that charge exchange at the surface is responsible for the reflection of ionic beams. Rather the data are best correlated with the proposal that the ejected surface atoms are excited by the ejected electrons and then undergo resonant ionization. The possibility of resonant ionization taking place in this system of helium and copper is discussed and it is shown that it is possible using potential energy curves for the interaction of helium metastable atoms and helium ions with copper. The effect of pressure on the ratio of electrons to ions ejected is investigated. It is found that the ratio increases when the helium background pressure increases. This effect is thought to be caused by the greater probability of helium atoms striking sorbed helium atoms and the consequent reduced production of excited atoms at the surface. An investigation is also made of the production of a blue color on molybdenum trioxide when bombarded with helium atoms. One possible origin is that the sorbed gases are being dissociated by the beam atoms and the free radicals produced are reacting with the molybdenum trioxide. Another cause is that the beam atoms are directly inducing a chemical change in the molybdenum trioxide itself.

27778 THE ELECTRONIC STRUCTURE OF LiH AND Li_2 AND THE QUADRUPOLE MOMENT OF Li^7. Sheldon Lee Kahalas (Boston Univ.). Dissertation Abstr., 22: 1217(Oct. 1961).

Hartree-Fock self-consistent-field calculations of the Roothaan (linear combination of atomic orbitals–molecular orbital) type are carried out on an electronic computer for LiH and Li_2 using an extended-basis set of Slater-type atomic orbitals (i.e., by the so-called SCF-LCAO-MO-STO method). Configuration-interaction calculations on LiH result in a total molecular energy of 99.34% of the experimental value, and a dissociation energy of 89.33% of the experimental value. Similar calculations in Li_2 result in 99.40% and 89.9% respectively for these two numbers. The energy of atomic Li, which enters the dissociation-energy calculation, is calculated to an accuracy of 99.42%. The electric field gradient is calculated (with configuration interaction) in LiH and Li_2. With the measured LiH quadrupole coupling constant, the quadrupole moment of Li^7 is found to be -3.56×10^{-26} cm^2. With the measured Li_2 quadrupole coupling constant, the quadrupole moment of Li^7 is found to be -4.5×10^{-26} cm^2. The best estimate for the magnitude is $(4.0 \pm 0.5) \times 10^{-26}$ cm^2; the sign is unambiguously determined to be negative, in agreement with theoretical predictions from nuclear models. The electric field gradient in Li_2 is found to be a sensitive function of internuclear distance. The dipole moment of LiH is calculated to be −5.83 Debyes and the quadrupole coupling constant of deuterium in LiD to be +39.24 kc. Large contributions in configuration interaction occur from $p\pi$ orbitals for LiH and Li_2 and from p orbitals for Li. No Sternheimer correction need be included in the calculation of the electric field gradient, when a Hartree-Fock wave function is used for a closed-shell atom or molecule. It is found that calculations for LiH and Li_2 by the SCF-LCAO-MO-STO method, used in conjunction with a large set of basis orbitals and configuration interaction, can yield results of sufficient accuracy that confidence may be placed in the theoretical description of molecular properties by this method.

27779 $\alpha^2 m/M$ CORRECTIONS TO HYPERFINE STRUCTURE IN ATOMIC HYDROGEN. Morton Maynard Sternheim (Columbia Univ., New York). Dissertation Abstr., 22: 1218(Oct. 1961).

The corrections to the ratio of the hyperfine structure of the 1s and 2s states of atomic hydrogen are evaluated using the Bethe-Salpeter equation. Adding the proton's nonrelativistic kinetic energy $p^2/2M$ and the effects of its Dirac and Pauli moments to the Dirac equation yields identical results. The theoretical R value is 34.43 ± 0.02, in agreement with the experimental value 34.49 ± 0.06.

27780 HYPERFINE STRUCTURE IN THE MICROWAVE SPECTRUM OF HDO, HDS, CH_2O, AND CHDO. BEAM MASER SPECTROSCOPY ON ASYMMETRIC TOP MOLECULES. Patrick Thaddeus (Columbia Univ., New York). Dissertation Abstr., 22: 1218(Oct. 1961).

Hyperfine structure in the $2_{20} \rightarrow 2_{21}$ rotational transitions of HDO and HDS near 10,278.2 and 11,283.8 Mc respectively, and in the $2_{11} \rightarrow 2_{12}$ transitions of CH_2O and CHDO near 14,488.6 and 16,038.1 Mc respectively, is investigated using a high resolution beam maser microwave spectrometer. Hyperfine coupling constants are determined. For HDO, an upper limit of 0.15 is set on the magnitude of the asymmetry parameter of the field gradient tensor about the OD bond.

27781 THE L AUGER SPECTRUM OF CESIUM-137-BARIUM-137. Audley Oliver Burford (Vanderbilt Univ., Nashville). Dissertation Abstr., 22: 1220-21(Oct. 1961).

The useful low energy limit of a beta spectrometer was extended to 2 kev by several modifications to the instrument. An amplifier and null motor of high sensitivity were installed in the control circuit, and the filter for removal of AC ripple in the generator output was located so that the lens-coil current was filtered before the error signal was taken from the loop. Measurements showed that these measures reduced current fluctuations to one part in 1000. Addition of new oil diffusion pumps to the vacuum chamber pumping system resulted in a static pressure of approximately 4×10^{-6} mm Hg. A side window Geiger counter was designed and constructed for detection of low energy electrons with 100 per cent efficiency. Tests indicated that the counter operated satisfactorily with gas pressures from 1.25 to 4.0 cm Hg and that there was no energy dependence in the counter efficiency for electrons above 2.5 kev energy. Techniques were developed that made possible the routine preparation of collodion counter windows sufficiently thin to be 100 per cent transparent to 2-kev electrons. Ultimately 3 μg cm^{-2} windows which could be used for 8 to 16 hours with a spectrometer pressure below 10^{-4} mm Hg were made with 40 per cent success; 4 μg cm^{-2} windows usable for 12 to 24 hours were made with 60 per cent success. It was found that a 4.8 μg cm^{-2} window was completely transparent to electrons of energies down to 1.7 ± 0.3 kev while 6 μg cm^{-2} windows would transmit 100 per cent of electrons above 3.2 ± 0.2 kev. The L Auger spectrum of Cs^{137}-Ba^{137} and the conversion electron lines of the 662-kev

gamma ray of Ba^{137} were measured with 3.2 per cent momentum resolution. The mean L fluorescence yield ($\bar{w}_L$) of barium was calculated from these data and a value of 0.248 was obtained. Because this value was in obvious disagreement with $\bar{w}_L = 0.148$ for barium interpolated from x-ray measurements and $\bar{w}_L = 0.10$ for xenon, the Auger intensities measured were assumed to be too low. Based on the slope of the x-ray data normalized to the xenon value the fluorescence yield for barium was found to be 0.116, and the experimental Auger intensities were increased to give that value. Values consistent with the corrected experimental results and known values for L subshell fluorescence yields were calculated. That the various Coster-Kronig transition probabilities were of the magnitudes observed indicated without question the importance of transitions of the type L_1-L_1N when they are energetically possible.

27782 THE INTERACTION OF TRITONS WITH MATTER. William Newberry Bishop (Univ. of Florida, Gainesville). Dissertation Abstr., 22: 3003(Mar. 1962).

Attempts were made to study the forward-hemisphere thick-target cross sections of triton-induced reactions and the range and energy loss of tritons in various substances. The tritons were produced by the $Li^6(n,\alpha)H^3$ reaction using a collimated reactor neutron beam. The 2.736-Mev triton and 2.052-Mev alpha particle were correlated at 180°. For the reaction studies a thick target was placed between the triton source and the detector, and the pulse height spectrum from this detector was displayed on a multichannel analyzer. Another detector at 180° geometry was used to monitor the incident triton flux. The angular correlation between the particles enabled the use of coincidence techniques to reduce background effects. The types of detectors used were thin cesium iodide crystals, a proportional counter, and silicon surface-barrier detectors. The cesium iodide crystals and the proportional counter proved impractical as a result of excessively high gamma ray background effects. The silicon surface barrier detectors showed low response to gamma radiation; however, their small size reduced the counting rate to the extent that a prohibitively long time was necessary to record a meaningful number of events. The effect of random coincidences also added to the problems in the interpretation of the data. For these reasons it was possible only to place an upper limit on the cross sections. The experimental procedure used in the range and energy loss measurements was similar to that described. Silicon surface barrier detectors were used for particle detection. The triton spectrum was recorded for each absorber thickness through which the particles passed. The mean range was determined by counting the coincidence gate pulses as a function of absorber thickness. From these data range-energy and energy loss curves were constructed. The substances used for the range and energy loss measurements were aluminum, nickel, polystyrene, xenon, krypton, argon, air, and nitrogen. The estimated error for the ranges was approximately 1% and a 5% error was assigned to the energy loss measurements. The triton data was in general agreement with data for protons of the same velocity. Empirical relations of the form $R = aE^b + c$ were fitted to the data.

27783 AN APPROXIMATE WAVE FUNCTION FOR THE GROUND STATE OF ATOMIC Be. Floyd Leslie Brooks, Jr. (Univ. of Washington, Seattle). Dissertation Abstr., 22: 3003(Mar. 1962).

The ground state of atomic beryllium is treated by a variation-perturbation method. A calculation of the ground state energy is made, and the coefficients in the expansion of an approximate ground state wave function are determined. The method used involves the calculation of an approximate energy eigenvalue by the variation method. The remainder is then determined by use of an approximation formula. The approximate remainder is shown to be equivalent to a modified perturbation theory result. In the calculation a complete and discrete set of atomic orbitals is employed. Closed-form expressions are derived for all necessary integrals.

27784 ISOTOPE SHIFT IN THE ATOMIC SPECTRUM OF SILICON. Martin Edward Hoover (Univ. of Southern California, Los Angeles). Dissertation Abstr., 22: 3233 (Mar. 1962).

The isotope shifts of Si^{30} relative to Si^{28} as observed in eleven atomic spectral lines were presented. The high resolution necessary for these measurements was achieved by use of a Fabry-Perot interferometer in combination with a medium Hilger quartz-prism spectrograph. The spectra of two samples of elemental silicon, enriched to 72.56% in Si^{30} and 99.4% in Si^{28} respectively, were excited in two hollow cathode discharge tubes cooled in liquid nitrogen. Both tubes were attached to one end of a Pyrex ground joint which was mounted in a vertical position to permit a change from one source to the other by rotating the tube assembly. Neon was used at a pressure of approximately 0.40 mm Hg to carry the discharge. The isotope shift was calculated by comparing the Fabry-Perot ring diameters on photographic exposures from the two sources in accordance with the theory of the interferometer. The magnitudes of the observed shifts varied from $\Delta\nu \approx 0.011 \pm 0.001$ cm^{-1} for the ($3p^2\ ^3P$ — $3p4s\ ^3P$) transition to $\Delta\nu \approx 0.115 \pm 0.002$ cm^{-1} for the ($3p^2\ ^3P$ — $3p3d\ ^3D$) transition. Experimental results indicated that the specific mass shift of the $3p3d\ ^1D_2$ level relative to the $3p3d\ ^1F_3$ level was about seven times as large as the specific shift in the 2435 Å ($3p^2\ ^1D_2$ — $3p3d\ ^1D_2$) transition.

27785 HIGH ENERGY PARTICLE ANALYSIS IN EMULSIONS WITH A 200 KILOGAUSS MAGNETIC FIELD. Edward Donald Platner (Univ. of Washington, Seattle). Dissertation Abstr., 22: 3237(Mar. 1962).

A review is given of high intensity pulsed magnetic field technology. A study is made of switching circuitry for capacitor energy storage apparatus, the flux concentrator idea, and the design of tape-wound coils. The bidirectional character of high-current switches and the desire to limit magnetic coil heating leads to the development of a special switching circuitry. The net advantageous effect is to reduce coil heating 30 per cent over a simple "crowbar" circuit, as well as to eliminate reverse current problems with the switching device. Several flux concentrator coil structures are tested and an analytical study is carried out. It proves possible to materially prolong coil life or produce considerably higher fields with this device. However, the flux concentrator is inefficient (~3%) when used with tape-wound primaries and long field pulse times. Numerous tape-wound coils are built in an effort to ascertain the capabilities of these structures and to gain experience with a type of coil about which, in this application, little is known. This type of coil proves to be quite simple to build, very compact, and relatively easy to cool. Well-constructed units made of beryllium alloy copper tape with epoxy and fiberglas insulation have multihundred pulse useful lives at fields of 200 kilogauss. However, unless special winding techniques are utilized, these coils suffer rapid deterioration above 250 kilogauss. Coils of this type are not practical in helmholtz configurations for fields much over 150 kilogauss because of the difficulty in retaining the axial force. The application of a 200-kilogauss

magnetic field to particle analysis in nuclear emulsions is examined. Emulsions in the magnetic field are exposed to 1-Bev/c protons. Two-hundred-thirty of these proton tracks are coordinate scanned and their curvatures measured. An inverse momentum, q_m, is calculated from these curvatures. The expected distribution of q_m is calculated from the multiple scattering theory, initial q distribution, etc. The expected form of the distribution is gaussian of mean q_0 and standard deviation σ. For 1 cm track lengths, $q_0 = 1.07$ c/Bev and $\sigma = .225$ c/Bev; and for 2 cm track lengths, $q_0 = 1.07$ c/Bev and $\sigma = .15$ c/Bev. The measured distributions are: at 1 cm, $q_m = 1.013 \pm .027$ c/Bev and $\sigma = .227$ c/Bev; and at 2 cm, $q_m = 1.04 \pm .017$ c/Bev and $\sigma = .15$ c/Bev. Comparison of these data clearly shows agreement within the statistical uncertainties, thus substantiating the theoretical predictions. An effort is made to determine the accuracy with which the particle charge sign can be ascertained as a function of track length. The measurements agree with a simplified theory that is presented. It is shown that almost certain charge sign identification is possible for tracks of over 2 mm length, for $\beta = .7$ in a field of 200 kilogauss. The problem of emulsion distortion is investigated, and a method of compensating for all but 5 μ distortion saggitas (much less in some cases) is presented. A development procedure that can reduce distortion by as much as a factor of ten is described. It seems possible, with suitable distortion correction and reduction procedures, to measure momenta as high as 15 Bev/c on a 1 cm track at 200 kilogauss, with only 10 per cent error as a result of distortion.

27786 MULTIPLE-SCATTERING ANALYSIS OF THE THREE-BODY SCATTERING PROBLEM. Lee Henry Schick (Univ. of Colorado, Boulder). Dissertation Abstr., 22: 3238(Mar. 1962).

Several arguments are presented to show that it would be of great value to have a theoretical expression for the three-body scattering amplitude in terms of free-particle two-body scattering amplitudes for the pion-deuteron, kaon-deuteron, and nucleon-deuteron scattering problems. Theoretical investigations of these three-body scattering problems are reviewed briefly; detailed discussions of various methods of solving the two-body scattering problem and of previous treatments of the three-body scattering problem with fixed target particles are given. The problem of scattering of a scalar particle by a target composed of two scalar particles all of which interact via scalar potentials is reduced to the problem of the scattering of a particle by two potentials by the assumption that the target particles are infinitely massive compared to the incident particle. The assumption is made that the two potentials do not overlap. The Schroedinger equation is converted into a pair of coupled integral equations for the wave scattered by each well. The Green's function in each of these equations is just the total Green's function for the two-body scattering problem. The coupled integral equations are solved first for square well potentials and S-wave scattering; then for square well potentials and scattering of the first N partial waves; and, finally, for any two spherically symmetric wells with finite radii and scattering of the first N partial waves. A test of the separable potential approximation is made for S-wave scattering by two overlapping square wells. The effect of the recoil of the target particles is considered. The scattering amplitude for the general three-body problem is obtained as a multiple-scattering expansion in terms of bound-target two-body scattering amplitudes. These bound-target two-body amplitudes are reduced to free-particle two-body amplitudes for the special case in which there is no interaction between the target particles. The usual separable potential approximation is applied to the general three-body problem, but the multiple-scattering expansion of the total elastic scattering amplitude still contains unknown operators. A more general form of the separable potential approximation is applied to the general three-body problem, and the total elastic scattering amplitude is obtained in terms of a multiple-scattering expansion that contains the free-particle two-body amplitudes and certain average values of known operators. It is argued that this result includes some of the effects of the recoil and binding of the target particles.

27787 ZERO-MASS REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP. Derek W. Robinson (Eidenössische Technische Hochschule, Zurich). Helv. Phys. Acta, 35: 98-112(1962). (In English)

The zero-mass representations of the inhomogeneous Lorentz group are considered as contractions of the representations for real and imaginary masses. It is shown that all zero-mass representations may be obtained from contracting either real mass or imaginary mass representations, but that it is more reasonable to associate the representations describing zero-mass particles with infinite angular momentum with contractions of the imaginary mass representations. (auth)

27788 THE TEMPERATURE AND PRESSURE DEPENDENCE OF CRITICAL FIELD CURVES. C. A. Swenson (Ames Lab., Ames, Iowa). IBM J. research develop., 6: 82-3(Jan. 1962). (IS-303)

A brief discussion is given of the analysis of recent critical field measurements. In particular, a negative volume coefficient of thermal expansion is predicted for tin in the superconducting state. (auth)

27789 METHOD FOR THE DIRECT CONVERSION OF NUCLEAR ENERGY. [PART] II. Ezio Betti and Giancarlo del Corso (CAMEN, Leghorn). Ing. nucleare, 4: 182-8 (Sept.-Oct. 1961). (In Italian)

The possibilities for the conversion of nuclear energy by means of thermionic and magnetohydrodynamic methods are examined. The expression for the yield of a thermionic converter is given by assuming that the only heat loss is electron emission. On the basis of formulas derived in Part I, the value of the thermoelectric efficiency is given by considering the plasma thermionic converter as a thermocouple. (tr-auth)

27790 REMARKS ON THE MULTIPLE IONIZATION OF ARGON BY ELECTRON BOMBARDMENT FROM 0 TO 500 VOLTS. Florence Fiquet-Fayard (Faculté des Sciences, Orsay, France). J. chim. phys., 59: 439-41(May 1962). (In French)

The study of Ar by electron bombardment in a mass spectrograph shows that the ions Ar^{3+} and Ar^{4+} are formed abundantly beginning at 260 ev by a still unexplained process. The interpretation by the Auger effect runs into many difficulties. (tr-auth)

27791 METHOD FOR COMPUTING THE RADIAL DISTRIBUTION OF EMITTERS IN A CYLINDRICAL SOURCE. William L. Barr (Univ. of California, Livermore). J. Opt. Soc. Am., 52: 885-8(Aug. 1962). (UCRL-6440)

A method for computing the distribution of emitters from the observed projected intensity profile is described. The method is applicable to optically thin volume sources with cylindrical symmetry. Unlike previous methods, this method yields results which are relatively insensitive to small random errors in the data. (auth)

27792 THE PROPAGATION OF INTERATOMIC SHOCKS IN SOLIDS. J. Roussel (Centre d'Études Nucléaire, Saclay, France). J. phys. radium, 22: 764-9 (Nov. 1961). (CEA-1954). (In French)

The slowing down in a solid of a primary atom of high velocity occurs by means of a series of collisions able to displace secondary atoms. It is shown that under certain conditions, it is possible to channel the shocks along the length of a row of atoms without producing any new displaced atoms. This phenomenon is studied theoretically and demonstrated experimentally. (auth)

27793 STABILITY OF A FLOW BETWEEN TWO ROTATING CYLINDERS IN THE PRESENCE OF A CIRCULAR MAGNETIC FIELD. Kanefusa Gotoh (Kyoto Univ.). J. Phys. Soc. Japan, 17: 1053-61(June 1962). (In English)

The magnetohydrodynamic stability of laminar viscous flow between two rotating concentric circular cylinders in the presence of a circular magnetic field is discussed. Assuming that the difference between the radii of the inner and the outer cylinders is small compared with their arithmetic mean, the condition for the onset of instability is obtained. In a special case when $4\pi\nu\mu\sigma = 1$, a simple relationship exists between the eigenvalues in magnetic and nonmagnetic cases for arbitrary values of the amplification factor. (auth)

27794 A MISSILE TECHNIQUE FOR THE STUDY OF DETONATION WAVES. Fillmer W. Ruegg and William W. Dorsey. J. Research Natl. Bur. Standards, 66C: 51-8 (Jan.-Mar. 1962). (AFOSR-TN-61-394)

Problems and effects of stabilizing combustion and detonation against hypersonic flow were investigated by observation of a 20 millimeter spherical missile in a stoichiometric mixture of hydrogen and air at rest. Combustion produced detectable effects on the shape and position of the shock wave at Mach numbers between 4 and 6.5, and above pressures of one-tenth atmosphere. Chemical equilibrium probably was not reached in the time the gas spent near the front of the sphere. One of the factors in the delayed equilibrium was delayed ignition behind the shock wave, which was observed to be between about one and ten microseconds. Ignition delay is explained in terms of chemical kinetic theory and compared with results of experiments in shock tubes. Strong combustion-driven oscillations originated in front of the sphere, with frequencies up to about one-tenth megacycle per second. These were observed when the Mach number was less than 6 at a pressure of one-half atmosphere, and less than 5 at one-quarter atmosphere. A large reduction of the drag coefficient of the missile was noted in one case of intermittent combustion. (auth)

27795 CORRECTION OF THE ENERGY DEPENDENCE OF PLASTIC SCINTILLATORS BY INTRODUCTION OF ELEMENTS OF HIGHER ATOMIC NUMBER. R. Kempe (Technische Universitat, Dresden). Kernenergie, 5: 487 (June 1962). (In German)

Organic scintillators show in the energy range 0.2 to 3 Mev a low energy dependence, but under 200 kev the energy dependence falls abruptly. It is shown that the introduction of elements of higher atomic number in plastic scintillators would make possible an energy independent measurement of the γ dose output. The elements Fe, Br, I, Sb, Sn, Hg, and Pb were introduced into the scintillation plastics monostyrene and the phosphor PBD by polymerization. The results show that these elements permit energy-independent dose measurements. (J.S.R.)

27796 THE DEPENDENCE OF ELECTRON SCATTERING CROSS SECTION OF ATOMS ON THEIR ATOMIC NUMBER. M. L. De (Saha Inst. of Nuclear Physics, Calcutta). Naturwissenschaften, 49: 228-9(1962). (In English)

A comparison is made of the experimental and theoretical values of the scattering cross sections of C, Al, and Pd to determine if the cross section depends on the atomic number. It is observed that the experimental values increase with atomic number. (J.S.R.)

27797 RESONANCE AND THERMAL NEUTRON SELF-SHIELDING IN COBALT FOILS AND WIRES. T. A. Eastwood and R. D. Werner (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nuclear Sci. and Eng., 13: 385-90 (Aug. 1962).

An experimental study of neutron self-shielding in cobalt foils and wires has been made by an activation technique. Cobalt foils ranging in thickness from 0.0004 to 0.004 in. and 0.005 in. thick Co-Al alloy reference foils containing 1% Co were irradiated under cadmium in the NRX reactor. The Co^{59} specific activity in the pure foils was compared with that in the reference foils to give the gross self-shielding factors. Experimental resonance self-shielding factors were obtained by separating the 1/v part from the gross self-shielding factors, and agreement with calculated resonance self-shielding factors for foils was observed. Self-shielding factors for wire ranging in diameter from 0.001 to 0.025 in. and for 0.050 in. diam 1% Co-Al alloy wire were also measured since they are of practical importance and have not been calculated. Measurements of self-shielding factors for thermal neutrons were made for cobalt wires and these agree with theory. (auth)

27798 DYNAMICS OF BOILING WATER REACTORS WITH NATURAL CIRCULATION. A. Kirchenmayer (Technische Hochschule, Stuttgart). Nukleonik, 4: 122-37(Apr. 1962). (In German)

Earlier works on the transient behavior of boiling water reactors (J. Nuclear Energy, Pt. A. Reactor Sci. 12: 155(1960)) were expanded by considering the pressure and hydrodynamic effects in natural circulation. The position dependence of reactivity effects and current perturbation was considered; the mean steam bubble velocity is a function of the input velocity of the water, of the steam fraction, and of the pressure. The model admits the possibility of hydrodynamic oscillations. The power oscillations of the boiling water reactor in ship propulsion units can be calculated. The agreement of the calculated and experimental excursions of the EBWR is very good. (tr-auth)

27799 DIFFUSION OF ARGON-41 IN CALCIUM FLUORIDE (RARE-GAS DIFFUSION IN SOLIDS 9). Torbjoern Lagerwall (Hahn-Meitner-Institut für Kernforsohung, Berlin). Nukleonik, 4: 158-61(June 1962). (In English)

Kinetic studies of the diffusion of Ar^{-41} in CaF_2 single crystals were carried out in the temperature range from 800 to 1300°C. The argon was obtained in the reaction $Ca^{44}(n,\alpha)Ar^{41}$ on irradiating the CaF_2 crystals in the core of the BER reactor, and was then released in post-activation diffusion experiments. The release curves are in close agreement with the kinetics of the pure diffusion process as derived by Inthoff and Zimen. The results indicate a single mechanism involved in the diffusion process over the whole range of temperatures giving an activation energy of 67.4 kcal/mole (2.92 ev) with a preexponential factor $D_0 = 2.5 \times 10^4$ cm^2/s. Probably the argon is diffusing as a neutral atom through the F^- lattice by means of vacancies and interstitials. (auth)

27800 A SIMPLE THEORY OF SUPERCONDUCTIVITY. F. Schwabl and W. Thirring (Univ. of Vienna). Nuovo cimento (10), 25: 175-82(July 1, 1962). (In English)

It is shown that a system of bosons exhibits the Meissner

effect if the quantum fluctuations of the field operators are neglected. This model is applied to the problem of flux quantization in a superconducting cylinder. Corrections due to a finite penetration depth and to an external magnetic field are calculated. (auth)

27801 THE MATHEMATICAL STRUCTURE OF THE BARDEEN-COOPER-SCHRIEFFER MODEL. R. Haag (Univ. of Illinois, Urbana). Nuovo cimento (10), 25: 287-99 (July 16, 1962). (In English)

The Bardeen-Cooper-Schrieffer model for an infinitely extended superconductor is analyzed mathematically. The reason for the solubility of the model is evident in this formulation. It is shown that the ground states with unsharp particle number belong to irreducible representations, and those with sharp particle number to reducible representations of the basic operator algebra. The connection between uniqueness of the ground state, irreducibility and linked cluster decomposition is reviewed. (auth)

27802 NONFREE PARAMAGNETIC RARE EARTH IONS WITH EVEN NUMBER OF ELECTRONS IN AN EXTERNAL MAGNETIC FIELD. N. V. Afanas'eva. Optics and Spectroscopy (USSR) (English Translation), 12: 251-4 (Apr. 1962).

The cases of C_{3h} and C_{3v} symmetry are considered. The matrix elements of the crystalline field potential, with consideration of the mixing of states in an external magnetic field, are calculated. The coefficients of the spin Hamiltonian are found for ions with integral J. The question of the energy levels is settled, making possible determination of the absorption lines for paramagnetic resonance studies of the material. (auth)

27803 SPECTRA OF DIVALENT RARE EARTH IONS IN CRYSTALS OF ALKALINE EARTH FLUORIDES. I. SAMARIUM. P. P. Feofilov and A. A. Kaplyanskii. Optics and Spectroscopy (USSR) (English Translation), 12: 272-7 (Apr. 1962).

The absorption and luminescence spectra of divalent samarium ions introduced into single crystals of Ca, Sr, and Ba fluorides are investigated at 293, 77, and 4.2°K. The absorption spectra are found to be similar, but an essential difference is found in the luminescence spectra when the host crystals are different. The surmise is made that the absorption spectra of all crystals investigated and the emission spectra of $CaF_2:Sm^{2+}$ are determined by transitions of electrons from the 4f shell into outer shells (5d, 6s, etc.). In the luminescence spectra of $SrF_2:Sm^{2+}$ and $BaF_2:Sm^{2+}$ the excited term ($^5D_0$) of the 4f shell, which in these crystals is located below the terms of the outer shell, is observed. (auth)

27804 ON THE ULTRAVIOLET ABSORPTION OF X-RAYED KCl CRYSTALS. N. P. Kalabukhov and P. A. Yurachkovskii. Optics and Spectroscopy (USSR) (English Translation), 12: 290-1(Apr. 1962).

Chemically pure KCl is recrystallized three times from distilled water, then crystallized into a single crystal in a quartz vessel by the Kyropoulos method. This specially purified crystal is then exposed to 50 ma of 50-kv x rays for one hour at room temperature. The uv absorption spectrum is measured at 200 to 900 mμ. The observed absorption bands arising from V centers include the V_3 band at 218 mμ and a band surmised to be a V_4 band at 260 mμ. (T.F.H.)

27805 PHOTOTRANSFER OF AN ELECTRON IN MeF_2-Eu,Sm MONOCRYSTALS. P. P. Feofilov. Optics and Spectroscopy (USSR) (English Translation), 12: 296-7 (Apr. 1962).

Alkaline earth fluoride single crystals that are activated by mixtures of Eu and Sm are considered, which are grown under condition such that only the more easily reducible is present in the divalent state, while the Sm remains trivalent. Short-term exposure of these crystals to light from a condensed spark or a Hg lamp, or to γ rays, causes a decrease in the luminescent and uv-absorption spectral intensities characteristic of Eu(II), and causes an increase in the luminescent and uv-absorption spectral intensities characteristic of Sm(II). It is hypothesized that phototransfer of an electron from the Eu(II) to the Sm(III) ions is the mechanism for the decrease in Eu(II) and the increase in Sm(II). The example of BaF_2 activated with Sm and Eu is described. Heating the crystal to 400 to 600°C returns the Eu and Sm concentrations to their pre-irradiation levels. (T.F.H.)

27806 SPUTTERING EXPERIMENTS INSIDE THE ELECTRON MICROSCOPE. Helmut Poppa (General Dynamics/Astronautics, San Diego, Calif.). Phil. Mag. (8), 7: 1013-24(June 1962).

Experiments are described in which an ion gun is attached to an electron microscope specimen chamber so that a thin film specimen can be bombarded and inspected repeatedly without exposure to the atmosphere. The influence of low-energy ion bombardment on the structure of thin polycrystalline and monocrystalline silver films is studied. Mention is made of the possibility of micromachining thin silver films by masking them with carbon films and then sputtering them. (auth)

27807 ON AN ANALYTICAL EXPRESSION FOR THE AXIAL FIELD OF ELECTROMAGNETIC LENSES. M. L. De (Saha Inst. of Nuclear Physics, Calcutta). Phil. Mag. (8), 7: 1065-7(June 1962).

An equation is shown for relating the physical parameters of an electromagnetic lens (viz., the central bore diameter, pole-piece spacing, and number of amp-turns through the coil) to the variation of the axial magnetic field along the axis. The equation may also be used to find the maximum value of the axial field, the half-width of the field, and other field parameters. The results obtained with this formula are compared with those of other analytical expressions and with experimental data. (T.F.H.)

27808 PRECURSOR EFFECTS AND ELECTRON DIFFUSION FROM A SHOCK FRONT. Lewis Wetzel (Brown Univ., Providence). Phys. Fluids, 5: 824-30(July 1962).

Electrical effects well ahead of an advancing shock front are considered. Certain of these effects are attributed to the diffusion of electrons through the shock front from the ionized region behind it. The diffusion hypothesis is examined in terms of a simple heuristic model, in which the diffusion is assumed to take place from a plane electron source moving with the shock velocity. According to this model, there is no true electron "front," as is suggested by some experiments with ionizing shocks. However, a transient in the electron distribution may give rise to a virtual front in certain experimental situations. Under reasonable assumptions, observations of precursor fronts are found to be consistent with the predictions of the model. (auth)

27809 AXISYMMETRIC SHOCKS IN THE NEWTONIAN LIMIT FOR NONRIGID BOUNDARIES. Leon N. Zadoff (Republic Aviation Corp., Farmingdale, N. Y.). Phys. Fluids, 5: 831-9(July 1962).

The natural generalization of the snowplow equation in two-dimensional axisymmetric or Cartesian geometries is a Newtonian approximation in which the possibility of surface deformation is admitted. Such a general Newtonian approximation is derived from the Lagrangian fluid

equations, using a ideal-gas model in the limit of strong shock and high density ratio across the shock front. In one dimension the result reduces properly to the snowplow equation. In two dimensions, if the surface is constrained and the motion steady, the result consists of the "Newtonian plus Busemann" terms. The general result contains in addition a Coriolis term. The general theory is applied to the evaluation of the pressure on the surface of a conical plasma whose vertex angle is decreasing uniformly with time. Although the results are derived for an ideal-gas model, they are applicable whenever dissociation and ionization take place behind a strong shock front. (auth)

27810 THE DEBYE TEMPERATURE OF IRON-57 IN COPPER FROM OBSERVATIONS OF THE MÖSSBAUER EFFECT. N. A. Dyson (University of Birmingham, Eng.). Phys. Letters, 1: 275-7(July 1, 1962). (In English)

Sources of Co^{57} in metallic copper lattices were used with stainless-steel absorbers to study the Mössbauer effect at 20 to 800°C. The magnitude of the effect, the size of the temperature shift, and the line width were measured. The recoilless radiation consisted of a single peak, and the spectrum was recorded as a function of temperature. Data are presented in graphical form. (L.N.N.)

27811 $I \neq 0$ COUPLING IN SUPERCONDUCTORS AND THE USE OF FIELD QUANTIZATION METHODS IN THE MANY BODY PROBLEM. A. Klein (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Phys. Letters, 1: 311-13(July 15, 1962). (In English)

Physics of a general Bardeen-Cooper-Schrieffer type of reduced Hamiltonian and the use and misuse of Green's function techniques are studied. A large but finite system of N particles is considered. Suspicions (R. Balian, et al., Phys. Rev. Letters, 8: 372(1961)) that the Green's function formulation as such is incomplete are allayed. (L.N.N.)

27812 ULTRASONIC ABSORPTION IN LIQUID HELIUM AT TEMPERATURES BELOW 0.6°K. K. Dransfeld (Univ. of California, Berkeley). Phys. Rev., 127: 17-20(July 1, 1962).

An explanation is given for the sound absorption observed in liquid He II in the phonon region below 0.6°K, arising from an interaction between acoustic phonons and thermal phonons. This interaction occurs between the acoustic wave and only those thermal phonons which propagate parallel to the wave. There is a "bunching" of thermal phonons within certain regions of the acoustic wave, analogous to the bunching of electrons in a traveling wave tube. The sound absorption calculated varies with temperature, frequency, and pressure in agreement with all available experimental data and is of the right order of magnitude. When the mean free path of the thermal phonons is reduced, for instance, by adding He^3, the absorption is expected to decrease. (auth)

27813 SPIN-LATTICE RELAXATION IN SOME RARE-EARTH SALTS AT HELIUM TEMPERATURES; OBSERVATION OF THE PHONON BOTTLENECK. P. L. Scott and C. D. Jeffries (Univ. of California, Berkeley). Phys. Rev., 127: 32-51(July 1962).

By observing the transient recovery of microwave paramagnetic resonance signals at $\nu \approx 9.3$ kMc/sec and $\nu \approx 34$ kMc/sec, the spin-lattice relaxation rate T_1^{-1} for the rare earth ions Nd, Pr, and Sm in the double nitrate $[La_2Mg_3(NO_3)_{12}\cdot 24H_2O]$ and for Ce and Nd in the ethyl sulfate $[La(C_2H_5SO_4)_3\cdot 9H_2O]$ are measured in the temperature range $1.4° < T < 5°K$. The direct process, $T_1^{-1} \propto T$, the Orbach process, $T_1^{-1} \propto \exp(-\Delta/kT)$; and the Raman process, $T_1^{-1} \propto T^7$ and T^9, are observed. The measured relaxation rates agree with theoretical estimates based on Orbach's phenomenological approach. For example, for 1% Nd in the ethyl sulfate with $z \perp H$ at $\nu = 9.3$ kMc/sec $T_1^{-1} = 1.7T + 3.6 \times 10^{-4}T^9$ sec^{-1}, as compared to the theoretical estimate, $T_1^{-1} = 1.4T + 1.3 \times 10^{-4}T^9$ sec^{-1}. The data, together with similar measurements, lead to the conclusion that spin-lattice relaxation at low temperatures in rare earth salts is understood. At the lowest temperatures, where the direct process dominates, instances of a spin-bath relaxation rate T_b^{-1} which is not the direct spin-lattice (i.e., spin-phonon) process, but rather a slower phonon-limited "bottle-neck" process, are observed in the double nitrate having a temperature dependence $T_b^{-1} \propto T^2$. This dependence with that on crystal size and paramagnetic ion concentration agrees with theoretical expectations. The data indicate that the hot phonon-bath relaxation time is the time taken by sound waves to traverse the crystal half-thickness. For 1% Pr in the double nitrate at 1.4°K the bottleneck is severe, the observed rate T_b^{-1} being $\sim 10^3$ times smaller than the true direct rate T_1^{-1}. (auth)

27814 PARAMAGNETIC RESONANCE BELOW 1°K: SPIN-LATTICE RELAXATION OF Ce^{3+} AND Nd^{3+} IN LANTHANUM MAGNESIUM NITRATE. R. H. Ruby, H. Benoit, and C. D. Jeffries (Univ. of California, Berkeley). Phys. Rev., 127: 51-6(July 1, 1962).

An apparatus is described for performing paramagnetic resonance experiments at $\nu \approx 9.6$ kMc/sec down to $T \approx 0.2$°K, obtained by adiabatic demagnetization. It is used to extend the spin-lattice relaxation rate T_1^{-1} measurements on Nd in the double nitrate $La_2Mg_3(NO_3)_{12}\cdot 24H_2O$ down to 0.3°K, where the direct process is well displayed. For $z \perp H$ the result is $T_1^{-1} = 0.3 \coth(h\nu/2kT)$ sec^{-1}, to be compared to the theoretical estimate $T_1^{-1} = 0.6 \coth(h\nu/2kT)$ sec^{-1}. At the lowest temperatures the relaxation rate tends toward the temperature-independent value of spontaneous phonon emission. For Ce in the double nitrate, the observed spin-bath relaxation rate T_b^{-1} below 1°K is not the direct spin-lattice relaxation rate, but rather a phonon-limited bottleneck rate $T_b^{-1} \propto \coth^3(h\nu/2kT)$ which is concentration dependent. The results are consistent with the bottleneck rate $T_b^{-1} \propto T^3$ observed for other ions at higher temperatures. A lower limit for the true direct process $T_1^{-1} > 20 \coth(h\nu/2kT)$ sec^{-1} is obtained. (auth)

27815 THEORY OF MAGNETIC RESONANCE IN THE HEAVY RARE-EARTH METALS. B. R. Cooper (Univ. of California, Berkeley), R. J. Elliott, S. J. Nettel, and H. Suhl Phys. Rev., 127: 57-68(July 1, 1962).

The spin-wave spectrum was calculated from a Hamiltonian including anisotropic exchange, axial and hexagonal anisotropy, and magnetic fields for the various types of magnetic order known to occur in the heavy rare-earth metals Tb-Tm. Attention is given to spin waves which can be excited by radiation. Because of the high anisotropy, most resonances occur in the infrared, where they are difficult to observe. However, those phases which show either ferromagnetic ordering with moments in the hexagonal planes, or spiral configurations of the moments in those planes, should display a microwave resonance when a suitably chosen magnetic field is applied in that plane. In the spiral phases an additional resonance with $\omega \propto H^3$ may also be observable. (auth)

27816 PRESSURE EFFECT AND THERMAL EXPANSION FOR SUPERCONDUCTING TIN. J. E. Schirber and C. A. Swenson (Iowa State Univ., Ames). Phys. Rev., 127: 72-6(July 1, 1962). (IS-398)

The superconducting critical field curve of white tin was measured at 1.15 to 3.7°K to 2800 bars using solid helium as the pressure transmitter. The results at T_c agree with

previous work. An analysis of the data indicates a relatively small pressure dependence of the electronic specific heat coefficient γ, and, consequently, a small electronic contribution to the thermal expansion in the normal state. The thermal expansion in the superconducting state is predicted to be large and negative, and extremely anisotropic. The deviation of the superconducting properties of tin from "simple similarity" is discussed. (auth)

27817 SPECIFIC HEATS OF RUBIDIUM AND CESIUM BETWEEN 1.3 AND 12°K. D. C. McCollum, Jr. and Henry B. Silsbee (Univ. of California, Riverside). Phys. Rev., 127: 119-20(July 1, 1962).

The specific heats of rubidium and cesium were measured at 1.3 to 12°K, and Debye Θ values for the two metals were calculated from the data. Each metal exhibited a maximum and a minimum Θ value in this temperature range. For rubidium, the minimum Θ was 50° at 3.3°K, and the maximum Θ was 56° at 9°K. For cesium, the minimum Θ was 36° at 2.0°K, and the maximum Θ was 45° at 9°K. (auth)

27818 LOW-TEMPERATURE RESISTIVITY MINIMA AND NEGATIVE MAGNETORESISTIVITIES IN SOME DILUTE SUPERCONDUCTING Ti ALLOYS. R. R. Hake, D. H. Leslie, and T. G. Berlincourt (Atomics International, Canoga Park, Calif.). Phys. Rev., 127: 170-9(July 1, 1962).

Electrical resistivities at 1.1 to 35°K and magnetoresistivities at 1.1 to 4.2°K were measured in dilute, superconducting hcp Ti alloys. Resistivity minima occurring between 14 and 18°K are observed in ≈99.92% pure Ti, and in Ti-Mn alloys with Mn concentrations between 0.02 and 2.0 at. % (nominal atomic percent). Negative magnetoresistivities between 2.6 and 7.2% at 30 kG and 4.2°K are observed in Ti-Mn alloys with Mn concentrations between 0.1 and 2.0 at. %. The absolute magnitude of the negative magnetoresistance increases as temperature decreases for $T_3 < T < 4.2$°K, where T_3 is the temperature at which the zero-field resistivity begins to decrease due to the onset of superconductivity. Field- and temperature-dependent Hall coefficients are observed at liquid helium temperatures in Ti containing Mn concentrations of 1.0 and 2.0 at. %. Ti alloys containing 1.2 at. % Cr and 0.96 at. % Fe display resistivity minima at about 17°K, but, unlike Ti-Mn alloys, they have small positive magnetoresistivities and do not exhibit field-dependent Hall coefficients at 4.2°K. Neither negative magnetoresistivities nor significant resistivity minima are observed in Ti containing 1.3 at. % Co, 1.0 at. % Ni, 1.1 at. % Al, or 1.0 at. % Nb. Considered in the light of ideas regarding the origin of the low-temperature resistive anomalies, the data suggest that localized magnetic moments exist in dilute superconducting Ti alloys containing Cr, Mn, and Fe, and that the conduction electrons interact with these moments. (auth)

27819 NONRADIATIVE E2 TRANSITIONS IN μ MESONIC ATOMS. J. E. Russell (Carnegie Inst. of Technology, Pittsburgh). Phys. Rev., 127: 245-6(July 1, 1962).

A μ^- meson, bound in a 3D orbit about a very heavy element, can make a nonradiative transition to the 1S state accompanied by electric excitation of the nucleus. A rough calculation, based on data on the photofission of U^{238}, indicates that this process may compete favorably with 3D → 2P x-ray emission. (auth)

27820 GENERAL THEORY OF PSEUDOPOTENTIALS. B. J. Austin, V. Heine, and L. J. Sham (Cavendish Lab., Cambridge, Eng.). Phys. Rev., 127: 276-82(July 1, 1962).

The energy levels of valence electrons in atoms, molecules, and solids can be calculated from a weak net effective pseudopotential V_p. In V_p, most of the large negative potential energy of an electron, when inside the ion core of an atom, was cancelled against the large positive kinetic energy which the electron has there. There are several different forms which the pseudopotential can take. The theory is developed from a different point of view, and it is shown that there exists an even wider class of pseudopotentials that all give the same valence energy levels. One of these, previously derived as an approximation, is an exact form of the pseudopotential. Since it is much simpler and more convenient than other forms, its properties are investigated further with a view to its use for detailed numerical calculations. The pseudopotential can be used not only for calculating valence energy levels, but also for the scattering of electrons by phonons and impurities in solids and by the disorder in liquid metals. (auth)

27821 ELECTRON DRIFT AND DIFFUSION MEASUREMENTS IN H_2 AND D_2 WITH CROSSED ELECTRIC AND STRONG MAGNETIC FIELDS. Melvin J. Bernstein (Univ. of California, Berkeley). Phys. Rev., 127: 335-41(July 15, 1962). (UCRL-10016)

In a strong magnetic field, the cyclotron frequency of the electron is much larger than the elastic-collision frequency with neutral molecules ($\omega_b^2\tau^2 \gg 1$). Expressions derived from the Boltzmann equation for the energy distribution, drift velocities, and diffusion coefficients in crossed electric (E) and magnetic (B) fields are simplified in the limit of a strong magnetic field, with the average electron energy a function of E/B. Experiments were done in a coaxial cylindrical geometry with E perpendicular to B. Measurements of the ratio of the perpendicular (E × B) to transverse (E) drift velocities in the range $12 < \omega_b\tau < 48$, and of diffusion parallel to B in the range $3 < \omega_b\tau < 8$, showed that the average energy is a function only of E/B, the perpendicular drift velocity. Curves were obtained for hydrogen, deuterium, and helium which give the transverse drift velocity in terms of the parameters E/B (cm/sec) and B/p (kG/mm Hg at 20°C). Comparison of drift velocity and diffusion measurements with theoretical expressions yielded a momentum-transfer cross section for H_2 which is 10 to 20% larger, in the range of 0.3 to 4 eV, than that obtained by other authors. Average electron energies of 0.3 to 4.5 eV were determined for hydrogen and deuterium as a function of E/B which ranged from 10^6 to 10^7 cm/sec; proper comparison with average energies measured as a function of E/p with B = 0 shows good agreement. The inelastic, molecular-excitation energy losses in H_2 are about twice those in D_2. (auth)

27822 TOWNSEND IONIZATION COEFFICIENT FOR HYDROGEN IN A TRANSVERSE STRONG MAGNETIC FIELD. Melvin J. Bernstein (Univ. of California, Berkeley). Phys. Rev., 127: 342-5(July 15, 1962). (UCRL-10017)

The Townsend ionization coefficient α/p (cm-mm Hg at 20°C)$^{-1}$ was measured across a strong magnetic field by varying the electrode gap in a cylindrical geometry. Measurements were made for B/p up to 4000 G/mm Hg at 20°C and for $E/p(1 + \omega_b^2\tau^2)^{1/2}$ less than 150 V/cm-mm Hg, where $\omega_b\tau$ is the ratio of the electron cyclotron to elastic-collision frequencies. A theoretical expression of Blevin and Haydon $\alpha/p = C_1(1 + \omega_b^2\tau^2)^{1/2} \times \exp[-C_2(p/E)(1 + \omega_b^2\tau^2)^{1/2}]$ is shown to fit the points well over a limited range of values. The effective collision frequency per mm Hg (3.1×10^9/sec) that makes the theory fit is about three-fifths of the average momentum-transfer collision frequency. Analysis shows that this discrepancy results from deviations in the electron distribution function because the actual elas-

tic-collision frequency is not the theoretically assumed constant. (auth)

27823 PHASE TRANSITION IN ELASTIC DISKS. B. J. Alder and T. E. Wainwright (Univ. of California, Livermore). Phys. Rev., 127: 359-61(July 15, 1962). (UCRL-6600-T)

The study of a two-dimensional system consisting of 870 hard-disk particles in the phase-transition region has shown that the isotherm has a van der Waals-like loop. The density change across the transition is about 4% and the corresponding entropy change is small. (auth)

27824 THERMAL CONDUCTION IN LIQUID HELIUM II. I. TEMPERATURE DEPENDENCE. C. E. Chase (Massachusetts Inst. of Tech., Lexington). Phys. Rev., 127: 361-70(July 15, 1962).

The thermal conductivity of liquid helium contained in a cylindrical stainless-steel capillary 0.080 cm in diam by 5.16 cm long has been studied between 0.9°K and the λ point. The relation between temperature gradient and heat current density W for heat currents greater than the critical heat current density W_c is best expressed in the form $\text{grad}T = DW^n$, where D is a temperature-dependent constant and n varies from about 3.0 at low temperatures to about 3.5 above 1.7°K. Below W_c the temperature gradient is much smaller, and is determined entirely by the viscosity of the normal component. W_c was measured over the entire temperature range by a combination of two methods, which are in complete agreement in the region of overlap. The results suggest that, below about 1.7°K, W_c is the result of some sort of normal turbulence describable by a Reynolds number involving the normal fluid velocity but the total density. At higher temperatures such an explanation is no longer adequate, and some other type of critical velocity must be invoked. (auth)

27825 LIFETIMES OF QUASI-PARTICLES AND PHONONS IN A SUPERCONDUCTOR AT ZERO TEMPERATURE. Ludwig Tewordt (Univ. of Notre Dame, Ind.). Phys. Rev., 127: 371-82(July 15, 1962).

General expressions for decay rates of a quasi-particle and a phonon in a superconductor at zero temperature are obtained from Nambu's nonlocal self-consistency conditions. The valid coherence factors in the transition probabilities are encountered for the different processes we consider. The decay rate of a quasi-particle due to emission of single phonons is found to vanish with the $\frac{7}{2}$ power of its excess excitation energy above the gap. The contribution to decay arising from emission of single pairs of particles via Coulomb interaction turns out to be at the most a few percent of that coming from phonon emission. The level width of a phonon caused by decay into single pairs of particles is shown to rise like a step function from zero to $\pi/2$ times the normal state value when the phonon energy reaches twice the gap energy. Additional contributions to particle decay arising from two-phonon emission or, from single pair emission, are obtained from the second-order self-energy diagram. The two-phonon emission effect is found to be completely negligible in comparison to that due to single phonon emission. (auth)

27826 CRITICAL FIELDS OF THIN SUPERCONDUCTING FILMS. I. THICKNESS EFFECTS. A. M. Toxen (International Business Machines Corp., Yorktown Heights, N.Y.). Phys. Rev., 127: 382-90(July 15, 1962).

A theoretical model is presented with which the critical magnetic fields of thin superconducting films can be calculated from any theory of superconductivity for which the kernel of the current-vector potential relationship is known. The model is worked out in detail for the nonlocal theory of Pippard with specular boundary conditions, and the critical field is shown to be a function of film thickness and the nonlocal parameters ξ and $\xi_0\lambda_L^2$. The results are compared to critical-field data for pure indium films and are found to predict very well the observed thickness dependence of critical field. On the basis of reasonable assumptions, ξ_0 and $\lambda_L(0)$ are calculated from the indium critical field data to be 2600 ± 400 Å and 350 ± 30 Å, respectively. (auth)

27827 SPECTROSCOPY AND OPTICAL MASER ACTION IN $SrF_2:Sm^{2+}$. P. P. Sorokin, M. J. Stevenson, J. R. Lankard, and G. D. Pettit (International Business Machines Corp., Yorktown Heights, N. Y.). Phys. Rev., 127: 503-8 (July 15, 1962).

A crystal of $SrF_2:Sm^{2+}$ was operated as a pulsed optical maser at temperatures close to 4.2°K. The 6969 Å output corresponds to the wavelength of an exceedingly sharp line ($\Delta\nu < 0.6$ cm^{-1}) in which almost all of the low-temperature fluorescence is concentrated. In contrast to what prevails in $CaF_2:Sm^{+2}$ masers, the output is characterized by strong relaxation oscillations. This may be explained by the large difference in the fluorescent lifetimes in the two systems. While in $CaF_2:Sm^{2+}$ the value of τ is approximately 1.5×10^{-6} sec, in $SrF_2:Sm^{2+}$ it has a value of 15 msec. The reason for the large difference in τ values, in turn, depends upon the relative proximity of the long-wavelength edge of the red band to the position of the metastable $^5D_0$ level from which fluorescence occurs. Absorption measurements taken at helium temperatures on $SrF_2:Sm^{2+}$ show that the lowest vibrational level of the lowest lying 4f–5d band lies ~600 cm^{-1} above the position of the $^5D_0$ level while in $CaF_2:Sm^{2+}$ there is near coincidence of the corresponding levels and consequently strong configurational mixing. Crystals of $SrCl_2:Sm^{2+}$ were also studied in this regard and display an expected close similarity in spectral characteristics to $SrF_2:Sm^{2+}$. The vibrational structure on the 4f–5d bands is much more pronounced, however, than in $CaF_2:Sm^{2+}$ and $SrF_2:Sm^{2+}$, indicating weaker coupling to the lattice in the excited 5d state. A tentative interpretation for the splitting of the red band seen in the absorption spectra of Sm^{2+} ions is given. (auth)

27828 EXCITED S STATES OF HELIUM. C. L. Pekeris (Weizmann Inst., Rehovoth, Israel). Phys. Rev., 127: 509-11(July 15, 1962).

As part of a program aiming to determine all the observed term-values of two-electron atoms on the basis of the Schrödinger wave equation, the 1s ns levels of helium up to n = 9, in both the singlet and the triplet states were evaluated. The previous method, using perimetric coordinates, was extended to allow for the asymmetry between the 1s and the excited electrons. The mass polarization and relativistic corrections were also determined. The difference between the ionization energies J(220), obtained by solving a determinant of order 220, and the experimental values, ranges from 3.6 cm^{-1} for $3\,^1S$ to 5.8 cm^{-1} for $9\,^1S$, and from 0.5 cm^{-1} for $3\,^3S$ to 5.7 cm^{-1} for $9\,^3S$. The extrapolated values indicate that with a faster computer than WEIZAC it should be feasible to determine all of the 31 observed 1s ns levels ($n \leq 17$) of helium to within the experimental accuracy. (auth)

27829 ENERGY SHIFTS OF THE MAGNETIC SUBLEVELS OF $^3S_1$ HELIUM CAUSED BY OPTICAL PUMPING. L. D. Schearer (Texas Instruments Inc., Dallas). Phys. Rev., 127: 512-17(July 15, 1962).

It has been observed experimentally that the energy spacing between the magnetic sublevels of the $2\,^3S_1$ state of helium as detected by optical pumping varies with the in-

tensity and character of the resonant radiation. The relative shift as a function of the intensity, polarization, and spectral distribution are observed and measured. The energy shifts are on the order of 50 to 60 cps and become smaller as the intensity of the light decreases. A second lamp containing He^3 incident on the absorption cell in the same manner as the pumping lamp also produces an energy shift. An explanation of the light shift in metastable helium is discussed. (auth)

27830 APPLICATION OF MØLLER'S THEORY ON ENERGY AND ITS LOCALIZATION IN GENERAL RELATIVITY. Petros S. Florides (Dublin Inst. for Advanced Studies). Proc. Cambridge Phil. Soc., 58: 102-9(1961).

Møller's theory on the concept of energy and its localization in general relativity is applied to calculate the energy of the interior and exterior Schwarzschild fields. It is found that the energy is equal to the (Newtonian) gravitational mass of the material system associated with the fields and that all the energy resides wholly in the material system. (auth)

27831 THE ELECTROMAGNETIC ENERGY AND THE GRAVITATIONAL MASS OF A CHARGED PARTICLE IN GENERAL RELATIVITY. Petros S. Florides (Dublin Inst. for Advanced Studies). Proc. Cambridge Phil. Soc., 58: 110-18(1962).

The electromagnetic energy $\mathcal{E}$ of the field of a charged particle is calculated, using Møller's theory. The contribution of $\mathcal{E}$ to the gravitational mass of the charged particle is discussed, by studying the behavior of a neutral test particle in its field. The conclusion is that $\mathcal{E}$ gives rise to an 'effective' gravitational mass of the charged particle, which is equal to the (Newtonian) gravitational mass of the charged particle, plus the mass-equivalence of $\mathcal{E}$. This is contrary to the idea that the 'effective' gravitational mass is equal to the 'Newtonian' gravitational mass of the charged particle. (auth)

27832 ELECTROVAC UNIVERSES. Markandeya Misra (Banaras Hindu Univ., India). Proc. Natl. Inst. Sci. India. Pt. A, 28: 105-19(Jan. 26, 1962). (In English)

The static, axially-symmetric metric is considered in the oblate spheroidal co-ordinates associated with the canonical co-ordinates of Weyl, and twelve exact solutions of Einstein-Maxwell field equations in vacuo are obtained. They include all solutions in which the 4-potential depends on only one of the two variables considered. (auth)

27833 TRANSFORMATION LAWS OF VELOCITY AND ACCELERATION OF A PARTICLE ACCORDING TO RELATIVISTIC CONFORMAL TRANSFORMATIONS AND PHYSICAL INTERPRETATION OF THE LATTER. L. M. Bali and Vachaspati (Univ. of Lucknow, India). Proc. Natl. Inst. Sci. India. Pt. A, 28: 132-9(Jan. 26, 1962). (In English)

Difficulties in the physical interpretation of the conformal transformations, $x'_\mu = (x_\mu - \frac{1}{2}x^2 a_\mu)/[(1 - (ax) + \frac{1}{4}a^2x^2)]$, $(\mu = 0, 1, 2, 3)$, are pointed out. For two observers, situated in co-ordinate systems X and X', explicit relations between the velocities and the accelerations of a particle are found. The initial velocity of a particle instantaneously at the origin of one of the co-ordinate systems is the same in the two systems no matter what the values of the parameters a_μ are. The three parameters, $-\vec{a}$, represent the initial acceleration of the origin of the X-system relative to the X'-system. This interpretation of $\vec{a}$ holds for short times only such that $\vec{a}^2 t^2 < 2/3$; for later times, it fails because the terms in the transformation equation for acceleration are functions both of time and of a_μ. No interpretation for a_0 was found. (auth)

27834 THE PHOTOLUMINESCENCE DECAY OF ORGANIC CRYSTALS. J. B. Birks, T. A. King, and I. H. Munro (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 80: 355-61(Aug. 1, 1962).

The photoluminescence decay of single (1 cm^3) organic crystals is observed over the time interval 0 to 250 nsec, using a pulsed light source, fast photomultiplier, and pulse-sampling oscilloscope. The initial decay is exponential with decay time τ_0: anthracene (fresh surface) 25.8 nsec; naphthalene 82 nsec; p-terphenyl 6.2 nsec; and trans-stilbene 6.0 nsec. The decay of anthracene with an aged surface approximates to two successive exponentials with $\tau_1 \sim 16$ nsec and $\tau_2 \sim 32$ nsec. The decays of trans-stilbene, anthracene (fresh surface) and p-terphenyl are exponential over 100 nsec (~17 decay periods), 250, and 100 nsec respectively. (auth)

27835 LATTICE DYNAMICS OF MAGNESIUM. M. F. Collins (Cavendish Lab., Cambridge, Eng.). Proc. Phys. Soc. (London), 80: 362-72(Aug. 1, 1962).

The phonon dispersion relations in a principal plane of a magnesium single crystal are obtained from the inelastic scattering of neutrons. It is shown that in the Born-von Kármán theory, the interatomic forces must extend to third and possibly fourth nearest neighbors. The interaction with the twelve nearest neighboring atoms is found to be predominantly central in character. (auth)

27836 ELECTRON CAPTURE PROCESSES FOR MULTIPLY CHARGED IONS. J. B. Hasted and A. Y. J. Chong (University Coll., London). Proc. Phys. Soc. (London), 80: 441-9(Aug. 1, 1962).

Measurements are reported of the total charge transfer cross sections of Kr^{2+}, Kr^{3+}, and Kr^{4+}, in Ne and He, for ions accelerated through potential differences of 100 to 3000 v. The data are interpreted in terms of the pseudo-crossing of potential energy curves. On the assumption that for each capture process transitions only occur at a certain nuclear separation R_x, an attempt is made to relate the potential energy curve separation ΔU_{R_x} at this point with R_x^{-4}. (auth)

27837 THEORY OF SECONDARY EMISSION OF ELECTRONS IN HYDROGEN. Eifionydd Jones and F. Llewellyn Jones (University Coll. of Swansea). Proc. Phys. Soc. (London), 80: 450-64(Aug. 1, 1962).

A theoretical investigation of the mechanism of ejection of secondary electrons at the cathode surface in electric discharges in hydrogen is described. Theoretical estimates of the magnitude of the coefficient δ/α (representing photoelectric emission) are obtained from the energy balance equation of an electron stream moving in a gas under the influence of an electric field. The magnitudes of the coefficient γ (representing the effect of ions) are obtained from the theory of resonance neutralization and Auger neutralization and de-excitation of an ion at a metal surface. Comparison is made between these theoretical estimates and values of γ and δ/α obtained from an analysis of the measurements of the temporal growth of ionization currents. Agreement is obtained when the comparison is made at low values of the ratio of the electric field E to gas pressure p (i.e., in the range $E/p \sim 50$ v cm^{-1} mm Hg^{-1}). At larger values of E/p (~200 v cm^{-1} mm Hg^{-1}) the agreement is satisfactory only when the mobility of hydrogen ions is taken to be about 20 $cm^2 sec^{-1} v^{-1}$ when computing γ and δ/α from the experimental data on temporal growth of ionization. This value of the ion mobility is about three times greater than the value obtained by linear extrapolation of experimental data for values of $E/p < 100$ v cm^{-1} mm Hg^{-1}. The separate contributions to

the total γ of the various processes of neutralization and subsequent electron ejection from the cathode are estimated over the range of E/p from 50 to 250 v cm^{-1} mm Hg^{-1}. (auth)

27838 MAGNETOHYDRODYNAMIC GENERATION WITH ELEVATED ELECTRON TEMPERATURE. J. K. Wright and D. T. Swift-Hook (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). Proc. Phys. Soc. (London), 80: 465-71(Aug. 1, 1962).

It is shown that in certain cases the Joule heating in a magnetohydrodynamic generator is sufficient for the electron temperature to be raised above that of the heavy gas particles. The practical application of the resulting increase in ionization, and hence in electrical conductivity, is discussed. (auth)

27839 BALMER LINE PROFILES IN A CAPILLARY ARC DISCHARGE. V. Vujnovic, J. A. Harrison, and J. D. Craggs (Univ. of Liverpool). Proc. Phys. Soc. (London), 80: 516-22(Aug. 1, 1962).

Measurements of Balmer-line profiles in a hydrogen arc are described. The arc is confined in a quartz capillary tube and observed axially through hollow copper electrodes, so that profiles from the uniform central region of the plasma are obtained. The arc is produced by current pulses lasting one millisecond. The light is recorded with a spectrograph and photomultiplier, the output of which is displayed on an oscillograph. The profiles are constructed afterwards from a series of oscillographic photographs, each of which gives the whole of the time variation of one wavelength. Agreement is obtained between the theoretical profiles and the measured profiles for H_β, H_γ, and H_δ; and ion densities obtained from these also show agreement with one another. The H_α profiles do not fit the theoretical curves as well as do the others, and it appears that self-absorption is occurring in this case. (auth)

27840 ON THE T_e VALUES FOR THE $A^2\Pi \rightarrow X^2\Sigma$ STATE OF MgH AND MgD BANDS. M. Aslam Khan (Univ. of Karachi, Pakistan). Proc. Phys. Soc. (London), 80: 533-4(Aug. 1, 1962).

T_e values for the analogous bands of MgH and MgD for the transition $A^2\Pi \rightarrow X^2\Sigma$ are calculated. The vibrational constants of MgH for this transition are also reviewed, and accurate values are obtained. (auth)

27841 A METHOD FOR OBTAINING THE VIBRATIONAL WAVE FUNCTIONS APPROPRIATE TO THE TRUE POTENTIAL ENERGY CURVES OF DIATOMIC MOLECULES. D. C. Jain and P. Sah (Banaras Hindu Univ., Varanasi, India). Proc. Phys. Soc. (London), 80: 535-33(Aug. 1, 1962).

A method is suggested for obtaining the vibrational wave functions appropriate to the true U(r) curves of diatomic molecules by the application of the Wentzel-Kramers-Brillouin (WKB) method. The method consists in dividing the true U(r) curve into a number of segments and determining a quadratic expression in r, representing the U(r) curve, for each segment. These quadratic expressions are then used for evaluating the phase integrals. For checking the accuracy of the wave functions thus obtained, the Morse wave functions of a number of vibrational levels of various molecular electronic states, computed by the WKB method, are compared with their exact Morse wave functions and agreement is found between the two values. The proposed method is applied to obtain the true wave functions of the fourth and sixth vibrational levels of the $A^3\Pi_g$ state of C_2 and of the zeroth, first, and tenth vibrational levels of the $A^1\Sigma^+$ state of RbH. The general shape and anharmonicity of these wave functions are observed to behave as expected from the nature of their true U(r) curves. Further, the deviation of the true wave functions of the fourth and sixth vibrational levels of the $A^3\Pi_g$ state of C_2 from the exact Morse wave functions is found to be large in comparison with the error in the WKB wave functions. (auth)

27842 EXCITATION OF HYDROGEN BY ELECTRON COLLISION ALLOWING FOR EXCHANGE AND 1s-2s-2p STRONG COUPLING. R. Damburg and R. Peterkop (Inst. of Physics of the Latvian Academy of Sciences, Riga, USSR). Proc. Phys. Soc. (London), 80: 563-4(Aug. 1, 1962).

For total angular momentum L = 0, 1, 2, 3, and 4, partial 1s → 2s and 1s → 2p cross sections are calculated. Account is taken of exchange and all interactions involving the 1s, 2s, and 2p states of H. The sum of the partial cross sections for L = 5 to ∞ is calculated in the second Born approximation, for use in the total 2s and 2p excitation cross section computations. The polarization of resonance radiation produced by excitation of the 2p state is also determined. (T.F.H.)

27843 THE ABSORPTION OF SOUND IN DILUTE SOLUTIONS OF ^{3}He IN LIQUID HELIUM II. G. O. Harding and J. Wilks (Univ. of Oxford). Proc. Roy. Soc. (London), A268: 424-36(July 24, 1962).

The coefficient of the absorption of sound in dilute solutions of He^3 in liquid helium(II) is measured in the temperature range down to 0.4°K at a frequency of 14 Mc. Results are given for molar concentrations of He^3 of 0.32, 1.6, and 5.2%. In all cases the absorption is less than in pure helium(II), and the peak in the absorption-temperature curve is shifted to somewhat lower temperatures. It appears that the He^3 speeds up the interactions between the thermal excitations in the liquid, and thus reduces the second viscosity that is responsible for most of the absorption in pure helium(II) at the higher temperatures. The results are compared with a calculation of this effect. At lower temperatures the absorption arises from a different mechanism, and a treatment for this region taking into account the fact that all the relaxation times are long compared to the period of the sound wave is consistent with the results. This treatment involves the "bunching" of the thermal phonons by the sound wave. (auth)

27844 CHARGE TRANSFER IN COLLISIONS INVOLVING SYMMETRIC AND ASYMMETRIC RESONANCE. W. L. Fite, A. C. H. Smith, and R. F. Stebbings (General Dynamics Corp., San Diego, Calif.). Proc. Roy. Soc. (London), A268: 527-36(Aug. 7, 1962).

The cross sections for charge transfer in collisions between atomic hydrogen and O^+ and He^{2+} ions are presented. Interest attaches to these processes because they may occur with small or zero energy defect. Cross sections for symmetric resonance charge transfer between protons and atomic hydrogen are also presented for energies down to 20 ev. The experiments are carried out by techniques of modulated cross beams. (auth)

27845 CONVERSION OF HEAT INTO ELECTRIC POWER. Pawel Jan Nowacki and Zdzislaw Celiński. Przeglad Elektrotech., No. 3, 97-105(1961).

Three methods of converting heat into electric power were studied: thermoelectric, thermionic, and magnetohydrodynamic. Brief descriptions are given of the thermoelectrical generator SNAP III built in the USA in January 1959, two prototypes of thermionic generators built at Los Alamos, and research carried out on magnetohydrodynamic generators by Avco-Everett for the USAF. (OTS)

27846 A SENSITIVE METHOD FOR THE MEASUREMENT OF THE ELECTROSTATIC CHARGE OF NONCONDUCTING TARGETS IN BOMBARDMENT WITH POSITIVE IONS. H. Spehl (Universitat, Frieburg i. B.). Z. Physik, 168: 266-72(1962). (In German)

The charge accumulation on a nonconducting target during bombardment with accelerated ions is measured. By comparing the 340 kev $F^{19}(p,\gamma)$ resonance yield of a neutral hydrogen beam with the yield of free protons, the energy shift can be determined. For a 200 kev CaF_2 target this energy shift is found to be about 200 ev. Even for a 7 kev target the shift has the same order of magnitude. (auth)

27847 CALCULATIONS OF ENERGY TERMS FOR Pa ATOM. L. V. Popov (Inst. of Inorganic Chemistry, Siberian Branch of the Academy of Sciences, USSR). Zhur. Strukt. Khim., 3: No. 3, 299-315(May-June 1962). (In Russian)

The $5f^2\ 6d$ and $5f\ 6d^2$ energy terms of Pa were measured. (tr-auth)

27848 EXCITATION OF A WAVEGUIDE WITH PLASMA BY GIVEN CURRENTS. V. P. Demidov. Zhur. Tekh. Fiz., 32: 549-53(May 1962). (In Russian)

The excitation of a homogeneous infinite waveguide filled with cold plasma in a longitudinal magnetic field is studied; assuming the excitation system consists of conductors with assigned currents. The amplitudes of axially symmetric wave harmonics were determined, and two conductor configurations for wave excitation were calculated. (tr-auth)

27849 TRANSIT-TIME OSCILLATIONS IN INTENSE ELECTRON FLUXES. V. I. Volosov. Zhur. Tekh. Fiz., 32: 559-65(May 1962). (In Russian)

Transit-time oscillations in electron fluxes are oscillations with a period determined only by electron time-of-flight in the beam (or by their own beam parameter). It is shown that with intense electron fluxes and certain fulfilled conditions the transit-time oscillations occur with a retarding bremsstrahlung field. Data are given on such oscillations. The observed oscillations differ from the H. Barkhausen and K. Kurz oscillations which, in contrast to the observed oscillations, depend on the vacuum and the points of generation. The observed oscillation mechanism can be utilized in decimeter and centimeter wave generators with fast, smooth frequency change over. (R.V.J.)

27850 A STABLE CURRENT LIMIT IN A COMPENSATED ELECTRON FLUX. V. I. Volosov. Zhur. Tekh. Fiz., 32: 566-74(May 1962). (In Russian)

A simplified method is suggested for indicating the instability of an electron beam in relation to weak perturbations at a current above a certain maximum. This instability is exhibited in a monotonous periodic increase of small initial perturbations, resulting in a virtual cathode flux. Results of studies of maximum stability currents are included. The magnitude of the currents are in good agreement with theoretical values. (R.V.J.)

27851 THE MOTION OF INTENSIVE PULSE ELECTRON BEAMS THROUGH DIELECTRICAL PIPES. [PART] II. A. K. Berezin, V. G. Stupak, L. I. Bolotin, and G. P. Berezina (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR, Kharkov). Zhur. Tekh. Fiz., 32: 600-5 (May 1962). (In Russian)

The focusing properties of dielectric tubes for electron beams and the energy spectra of electrons in the beams were investigated. Fast and slow (secondary) electrons were observed in the spectra. The behavior of these two groups of electrons was studied in relation to beam power, current, and residual gas pressure. (R.V.J.)

27852 ERGODIC THEORIES. PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS "ENRICO FERMI," VARENNA ON LAKE COMO, VILLA MONASTERO, MAY 23–MAY 31, 1960. XIV COURSE. P. Caldirola, ed. New York, Academic Press, 1960. 250p.

Eleven lectures are presented, covering such topics as irreversibility; the representation of ergodic theory in classical statistical mechanics, quantum mechanics, and quantum statistical mechanics; the problem of master equations; and the mathematical, quantum, and kinetic structure of ergodic theories. (T.F.H.)

27853 ELEMENTARY QUANTUM FIELD THEORY. Ernest M. Henley and Walter Thirring. International Series in Pure and Applied Physics. New York, McGraw-Hill Book Company, Inc., 1962. 284p. $8.95.

Aspects of quantum field theory that are not obscured by mathematical difficulties and that do not require a deep understanding of special relativity are presented. Mathematical and physical descriptions of quantum fields are introduced, and conceptual aspects of such fields are discussed. Observables, invariants of the field, and internal symmetries are examined. Interactions of quantum fields with static sources are studied. Within this framework, both classical and quantum-mechanical analyses of problems known to have exact solutions (viz., the neutral scalar theory, the pair theory, and the Lee model) are carried out. The static model of Chew and Low is presented. In terms of this model, a study is made of pion-nucleon scattering, the static properties of nucleons, electromagnetic phenomena, and nuclear forces. (T.F.H.)

27854 FISSION FRAGMENT TRACKS IN THIN FILMS OF UO_2. T. S. Noggle and J. O. Stiegler (Oak Ridge National Lab., Tenn.). p.47-63 of "Symposium on Radiation Effects in Refractory Fuel Compounds." Special Technical Publication No. 306. Philadelphia, American Society for Testing and Materials, 1961.

Surface effects in UO_2 films produced by individual fission events which can be studied with the electron microscope offer promise of giving increased insight into the interaction of fission fragments with solids. Experimental techniques are described in which it is possible to identify the class of fragment giving rise to a particular length of track, the direction of travel of the fragment in producing the track, and the depth of the fragment below the free surface at points along the track. The results obtained using these techniques are correlated with the structures observed. The proposed mechanisms of energy loss of fission fragments are discussed and related to the studies of track structure. Results suggest that electron excitation and ionization energy loss is dominant in determining track registration. Finally, a new mechanism by which ionization energy may be converted into lattice damage is described. (auth)

27855 AN APPARATUS FOR THE INVESTIGATION OF HARD X-RAYS PRODUCED IN HIGH-POWER, PULSED GAS DISCHARGES. V. V. Matveyev and A. D. Sokolov. p.101-6 of "Uzly Novoy Apparatury Dlya Issledovaniya Yadernykh Izlucheniy; Nauchno-Technicheskii Sbornik." Moscow, Gosatomizdat, 1961.

An apparatus designed for the determination of the energy and time distribution of hard x rays emitted from high-power gas discharges of the type produced in laboratory experiments on controlled thermonuclear reactions is described. The x rays are detected by a scintillation counter (NaI; diameter 80 mm, height 80 mm). The pho-

plier is mounted on a photomultiplier, which has an intrinsic amplitude resolution of about 6%. The pulse from the photomultiplier is transmitted by a 50 m cable, the matching being achieved by a cathode follower. The pulses are amplified by the amplifier. The delayed pulse generator can be used to produce time windows between 10 μsec and 2 msec with a delay up to 10 msec. The pulses are recorded from the screen of a double-beam pulse oscillograph. The device was used to study x ray pulses produced during the operation of a pulsed toroidal chamber. (OTS)

27856 THERMOELECTRIC GENERATOR UNIT. Gunnar A. F. Winckler and Richard C. Evans (to United Nuclear Corp.). U. S. Patent 3,048,643. Aug. 7, 1962.

An efficient thermoelectric generator unit is designed which achieves a high efficiency by a combination of low thermal conductivity and high electric conductivity at the hot junction. One of the elements is formed in two main sections connected by a neck portion at the hot junction. (D.L.C.)

Astrophysics and Cosmology

27857 (CRSR-114) HYDROGEN NEAR THE MOON. Robert J. Gould (Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research). Apr. 1962. 7p.

The effect of solar proton bombardment of the moon's surface and the subsequent thermal re-evaporation of hydrogen gas were investigated. It was concluded that most of this gas would escape from the surface within a short time as neutral atomic hydrogen. Owing to the slow speed of the re-evaporating gas, the density would be several hundred times greater than the density of the high speed incoming gas. (N.W.R.)

27858 (CRSR-118) THEORETICAL RESEARCH IN ASTROPHYSICS. Final Report. (Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research). Apr. 30, 1962. Contract AF49(638)-915. 6p.

The progress made in the following investigations is briefly outlined and reviewed: abundance of molecular hydrogen in the galaxy, hydrogen atmosphere of the moon, interaction of a tenuous plasma with an antenna, infrared astronomy, plasma and magnetic fields in the solar system, magnetic effects of geomagnetically trapped particles, general relativity, and dynamics of insterstellar and interplanetary grains. (N.W.R.)

27859 (CRSR-119) DUST, RADIATION PRESSURE AND STAR FORMATION. Martin Harwit (Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research). May 1962. 26p. (AFOSR-2590)

Spitzer has shown that radiation can produce inverse square law attractive forces between absorbing interstellar grains. Whipple and Savedoff examined whether these forces could cause dust to flow through ambient gas and form dense clouds from which stars would form. Savedoff concluded that appreciable concentration of dust was not to be expected and that radiative effects would be small partly because grains have a high albedo. The present paper reexamines the problem by considering that instability analogous to gravitational instability can be produced by radiation and that in the neighborhood of hot stars, grains are subjected to high intensity, near ultraviolet irradiation for which the albedo probably is low. On this assumption the minimum mass of a cloud that becomes unstable at the center of an O association can be estimated. It is suggested that O clusters are formed in this manner. The process is of comparable efficiency to Oort's suggested compression by H II regions and moreover does not entail partial destruction of the cloud through ultraviolet ionization. Spitzer's radiative attraction does not appear to play a role with the free radical grains described by Platt since these grains effectively scatter but do not absorb radiation. They may, however, be subject to scattering pressures. A laboratory experiment to detect the radiative instability is proposed. It is shown that near hot stars, radiation pressures can accelerate clouds to speeds comparable to the velocity of interstellar clouds and members of stellar associations. Radiation pressures could also account for outflow of gas from galactic nuclei. (auth)

27860 (JPRS-13505) MAGNETISM IN SPACE. SERIES IX, PHYSICS AND CHEMISTRY. (Magnetizm v Kosmose. Seriya IX. Fiziki i Khimii). N. V. Pushkov. Translated from a Brochure of the "Znanie" Publishing House, Moscow, 1961. 64p.

The results of measurements of magnetic fields of the earth and moon, performed with the aid of magnetometers installed aboard satellites and rockets, are presented. The significance of the results in studying cosmic magnetism phenomena is explained. Information is also presented on radiation zones of the earth, geomagnetic storms and current systems lying outside the ionosphere, and magnetic fields in the external radiation zone and interplanetary space. (N.W.R.)

27861 NUCLEOSYNTHESIS DURING THE EARLY HISTORY OF THE SOLAR SYSTEM. William A. Fowler, Jesse L. Greenstein, and Fred Hoyle. Geophys. J., 6: 148-220(1962).

Abundances in terrestrial and meteoritic matter indicate that the synthesis of H^2, Li^6, Li^7, Be^9, B^{10}, and B^{11}, and possibly C^{13} and N^{15}, occurred during an intermediate stage in the early history of the solar system. In this intermediate stage, the planetary material had become largely separated, but not completely, from the hydrogen that was the main constituent of primitive solar material. Appropriate physical conditions were satisfied by solid planetesimals of dimensions from 1 to 50 meters consisting of silicates and oxides of the metals embedded in an icy matrix. The synthesis occurred through spallation and neutron reactions simultaneously induced in the outer layers of the planetesimals by the bombardment of high energy charged particles, mostly protons, accelerated in magnetic flares at the surface of the condensing sun. The total particle energy was approximately 10^{42} ergs while the average energy was close to 500 Mev per nucleon. Studies of the abundance of lithium in young T Tauri stars serve as the primary astronomical evidence for this point of view. The observed abundances of lithium and beryllium in the surface of the sun are discussed in terms of the astronomical and nuclear considerations brought forward. The isotope ratios $H^2/H^1 = 1.5 \times 10^{-4}$, $Li^6/Li^7 = 0.08$, and $B^{10}/B^{11} = 0.23$ are the basic data leading to the requirement that 10 per cent of terrestrial–meteoritic material was irradiated with a thermal neutron flux of 10^7 n/cm^2s for an interval of 10^7 years. The importance of the (n,α) reactions on Li^6 and B^{10} is indicated by the relatively low abundances of these two nuclei. It is shown that the neutron flux proposed is sufficient to produce the radioactive Pd^{107} and I^{129} necessary to account for radiogenic Ag^{107} and Xe^{129} anomalies observed in meteorites. The short time interval, $\sim 6 \times 10^7$ years, required for the radioactive decays to be effective applies to the interval between the end of nucleosynthesis in the solar system and the termination of fractionation processes in the parent bodies of the meteorites. It is not necessary to postulate a short time interval between the last event of

galactic nucleosynthesis and the formation of large, solid bodies in the solar nebula. (auth)

27862 TIME-DEPENDENT STRUCTURE OF THE UPPER ATMOSPHERE. Isadore Harris and Wolfgang Priester (National Aeronautics and Space Administration, Greenbelt, Md. and Inst. for Space Studies, New York). J. Atmospheric Sci., 19: 286-301(July 1962).

The physical properties of the upper atmosphere are determined mainly by heat conduction, the heat sources, and the barometric law. An analysis of the integro-differential equation that describes these physical processes is carried out. It is found that heating of the thermosphere by absorption of the solar extreme ultraviolet (EUV) radiation alone cannot explain the observed diurnal variation of density and temperature, since this absorption yields maximum of these properties at about 17 : 00 local time, instead of 14 : 00 where it is observed. Secondly, if the EUV flux is adjusted to give the observed average temperature, then the diurnal variation in density is much too large compared with the observed amplitude. Further, this model requires an extremely high efficiency for the conversion of EUV radiation into heat, if the required flux is compared with measurements of the EUV flux. Thus, it is necessary to have another heat source in addition to the heating from absorption of EUV radiation. If an additional heat source is used, which has a maximum at about 9 : 00 local time and a flux of 1 erg cm^{-2} sec^{-1}, a time-dependent model of the upper atmosphere is obtained that is in agreement with the observed densities. There is evidence that this additional heat source derives its energy ultimately from the solar corpuscular radiation. The results of calculations for a model in the equatorial and temperature zones of the earth are presented, for those times when the average solar activity corresponds to a solar radiation flux of 200×10^{-22} $wm^{-2}(cps)^{-1}$ at 10.7-cm wavelength. The physical properties (temperature, density, pressure, scale height, mean molecular weight, and the number densities of N_2, O_2, O, He, and H) are given as a function of local time for altitudes between 120 and 2050 km. (auth)

27863 EQUILIBRIUM OF CH AND CH^+ IN INTERSTELLAR SPACE. D. McNally (Univ. of London Observatory). Monthly Notices Roy. Astron. Soc., 124: 155-67 (1962).

The theory of surface reactions is extended to the formation of CH at the surfaces of charged interstellar grains. The rate coefficient for this reaction is calculated to be 1.6×10^{-16} cm^3 sec^{-1} at 100°K. The equilibrium of CH and CH^+ is then investigated for three different radiation fields. It is shown that surface reactions can account for the observed amounts of CH and CH^+ provided the intensity of the interstellar radiation in the neighborhood of the Lyman limit is sufficiently weak. In particular it is shown that a certain radiation field is too intense in this region to allow the reaction. Chemical exchange reactions are eliminated as possible molecule-forming reactions and, since radiative association is too slow to account for the observed densities, only surface reactions have a chance of being sufficiently fast to produce molecules. It is further shown that the interstellar grains are probably less dense than 1 g cm^{-3} if there are to many free atoms of carbon in interstellar space. (auth)

27864 A NEW UPPER LIMIT TO THE GALACTIC DEUTERIUM-TO-HYDROGEN RATIO. Sander Weinreb (Massachusetts Inst. of Tech., Cambridge). Nature, 195: 367-8(July 28, 1962).

Attempts were made to observe deuterium absorption in the Cassiopeia A radio source with a 85-ft telescope for 9 weeks. Results were negative, indicating that the N_D/N_H ratio is less than 1/13,000, or less than half the terrestrial value (1/6,700). (D.L.C.)

27865 THE NEUTRINO PROBLEM IN COSMOLOGY. S. Weinberg (Univ. of California, Berkeley). Nuovo cimento (10), 25: 15-27(July 1, 1962). (UCRL-9855) (In English)

The absence of an Olbers paradox for neutrinos shows that the average neutrino luminosity must fall off for older and more distant parts of the universe. Unlike the situation for light, the paradox could not be avoided by a red shift, and a strong constraint is placed on cosmological speculation. The ambient neutrino flux is finite in the modern steady state or evolutionary cosmologies, and is estimated at about 10^3 neutrinos/cm^2 s. Taking absorption of neutrinos into account does not affect these conditions, except that in the oscillating cosmologies there must recur periods when neutrino absorption is faster than neutrino emission. It is estimated that the onset of neutrino absorption for an oscillating universe comes when it has contracted by a (linear) factor of about 10^5, and absorption might not lower the neutrino population significantly until the contraction reaches about 10^{14}. (auth)

27866 INTERNAL STRUCTURE OF PLANETS. Mubarak Ahmed and V. K. Tewary (Delhi Univ.). Proc. Natl. Inst. Sci. India. Pt. A. 28: 191-8(Jan. 26, 1962). (In English)

The mass radius relation for cold bodies was obtained on the basis of Thomas Fermi Dirac theory of the atom. The effects of zero-point energy of phonons, exchange interactions, and correlation energy of the electrons were considered explicitly. Planetary material is in a condensed state. (auth)

Cosmic Radiation

27867 (D1-82-0189) ON THE DIRECTIVITY OF SOLAR PROTON EMISSIONS. John C. Noyes (Boeing Scientific Research Labs., Seattle). June 1962 12p.

A hypothesis is advanced that the detection or nondetection of energetic solar protons in the vicinity of the earth following large solar flares and continuum type IV radiation may be due in part to the direction of emission of the protons from the sun. It is hypothesized that the direction of emission of solar protons is the same as the direction of motion of the associated metric wave type IV source, in the general direction of a coronal streamer associated with the solar active region. The streamer may be inclined to the normal to the solar surface. Protons thus directed westward may have a better chance of being detected at the earth than those directed eastward, since in the former case propagation may be facilitated by extended solar magnetic field lines convex westward due to solar rotation. Several examples are given in support of the hypothesis, relating the direction of motion of metric wave type IV sources and the occurrence or nonoccurrence of solar protons at the earth, as indicated by polar cap absorption. (auth)

27868 (PAN-292/VI) RECENT STUDIES ON THE FIRE BALL MODEL. Marian Miesowicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1961. 11p.

Presented on the International Conference I.U.P.A.P. on Cosmic Rays, Kyoto, September 1961.

The results of a statistical analysis of angular distributions of secondary particles in jets of primary energy

higher than 10^{12} ev are presented. For jets with small evaporations (N_h less than 5), it was concluded that independently of any model the double maximum of the angular distribution of secondary particles is a feature of strongly anisotropic high-energy nuclear collisions. The two-center model described well the jets with $N_h < 5$ and $n_s < 20$, and the main arguments for the model are: two maximum angular distribution, isotropy in separate cones, and correlation between n_s, σ, and K (inelasticity). The two center model does not describe the group of jets with $N_h < 5$ and $n_s > 20$. (auth)

27869 SOME FEATURES OF THE RESPONSE OF NEUTRON MONITORS TO LOW-ENERGY PARTICLES INCIDENT ON THE TOP OF THE ATMOSPHERE. William Webber (Univ. of Minnesota, Minneapolis). Can. J. Phys., 40: 908-23(July 1962).

By comparing the measured intensities and spectra of solar particles at the top of the atmosphere with measured neutron monitor intensity increases at sea level for several solar particle events, a set of yield functions has been derived for these neutron monitors in terms of low-rigidity (0.5 to 2 Bv) particles incident on the top of the atmosphere. Various characteristics of the response of neutron monitors to solar flare particles are discussed. In particular a method is described by which the intensity increase vs. latitude curve for the neutron monitors during these events can be utilized to derive a measurement of the deviations in geomagnetic cutoff from those expected from the earth's internal field only. Applying this method to the November 15, 1960, event suggests that a ring current of $M = 0.6\ M_E$ and radius $R = 7.7\ R_E$ was flowing at 1130 UT on this day. (auth)

27870 SOFT CORPUSCULAR RADIATION. I. A. Savenko, P. I. Shavrin, and N. F. Pisarenko. Geomagnetizm i aeronomiya, 1: 875-9(Nov.-Dec. 1961).

The Scientific Research Institute of Nuclear Physics, Moscow State University, confirmed the presence of soft corpuscular radiation at altitudes of ~320 km by comparing readings of two radiation-measuring devices on the second Soviet space-ship-satellite. In the equatorial region of the Pacific Ocean, where it was found to be most intensive (5×10^9 particles/cm^{2}sec^1 sterad), this radiation has an energy of the order of 10^4 ev. The two devices were a photomultiplier and a scintillation counter. The former records x radiation with an efficiency of ≈100%, protons with an energy >1 Mev, and electrons with an energy >30 kev, but is not effective in recording γ radiation. (auth)

27871 SOLAR HIGH-ENERGY PARTICLES. G. M. Minasyan. Geomagnetizm i aeronomiya, 1: 933-5(Nov.-Dec. 1961).

High-energy particles emitted during large chromospheric flares, known to be responsible for short-wave radio blackout and increased absorption of galactic radio noises in the polar region, were investigated on the basis of vertical sounding data. It was found that both protons (with energies ≤200 Mev) and hard particles (with energies ≤2 to 3 Bev) may occur among the high-energy particles. The protons penetrate to a latitude of about 63°N, while the hard particles reach to about 57.7°N. In an earlier study by the same author the velocity of the highest energy particles was found to be in the range of $(0.4 \text{ to } 3.0) \times 10^{10}$ cm/sec. (OTS)

27872 NUMBER OF N_2^+, N^+, N^{++} AND O_2^+, O^+, O^{++} IONS PRODUCED BY SOLAR PROTONS IN THE EARTH'S ATMOSPHERE. S. N. Ghosh and B. N. Srivastava (Univ. of Allahabad, India). Indian J. Phys., 36: 129-36(Mar. 1962). (In English)

The total number of nitrogen and oxygen ions (N_2^+, N^+, N^{2+}, O_2^+, O^+, and O^{2+}) formed by solar protons of initial energies 57 and 100 kev between 130 km and the altitudes for complete absorption (112 km for 57 kev and 106 km for 100 kev) is estimated. As these protons penetrate through the atmosphere, they undergo different inelastic collisions with atmospheric gases, e.g., charge exchange, ionization, and dissociation followed by ionization. For calculations of the ion formation, laboratory measurements of cross sections for different inelastic reaction collision for reactions (H^+, N_2) and (H^+, O_2) are utilized. Probability curves for different types of nitrogen and oxygen ion formation at different altitudes between the range 125 to 105 km by 57 and 100 kev protons are also drawn. (auth)

27873 EXPERIMENTAL DATA ON NUCLEAR-NUCLEON INTERACTIONS AT ENERGIES OF HUNDREDS OF Bev, AND THEIR INTERPRETATIONS. V. V. Guseva, N. A. Dobrotin, N. G. Zelevinskaya, K. A. Kotel'nikov, A. M. Lebedev, and S. A. Slavetinskiĭ (Lebedev Inst. of Physics, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 549-57(Apr. 1962). (In Russian)

Results of experiments at 3860 m, using two cloud chambers with a layer of LiH between them are reported. With this arrangement, and an array of counters, the following parameters for each shower could be determined: the initial energy E_0, whether a neutral or charged particle caused the interaction, number of charged secondaries, the momentum of secondaries, emission angle of secondaries, and the ionization density of secondaries. The data fall into three broad categories: symmetric showers with small coefficients of inelasticity, asymmetric showers where one of the inelasticity coefficients (K_{lab} or K_{refl}) is considerably larger than the other, and symmetric showers where both inelasticity coefficients are large ($K > 0.4$). These are interpreted as indicating in the first case the interaction between peripheral regions of nucleons, in the second the interaction of a nucleon core with a periphery, and in the third a core-core interaction. Evidence is presented to support Heisenberg's theory of multiple production. The transverse pion momentum was found to be 0.3 to 0.4 Bev/c, and independent of M, the mass of the excited system. This leads to a constant disintegration temperature, independent of M. (TTT)

27874 INVESTIGATION OF INTERACTIONS OF HIGH-ENERGY PARTICLES WITH ATOMIC NUCLEI, AT MOUNTAIN ALTITUDES. Kh. P. Babayan, Ya. S. Babetskii, N. G. Boyadzhyan, Z. A. Buya, N. L. Grigorov, E. S. Loskevich, E. A. Mamidzhanyan, E. I. Massal'skii, A. A. Oles', Ch. A. Tret'yakova, and V. Ya. Shestoperov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 558-71(Apr. 1962). (In Russian)

A 10-m^2 counter array, with several layers of counters and Pb and C absorbers was used to study high-energy cosmic ray interactions at 3200 m. It was found that spectra of ionizing events depend strongly on the size of the apparatus. In the region from 3×10^{11} to 10^{13} ev the spectrum of events falls uniformly as the spectrum of nuclear-active particles, showing no "breaks." Results show that π^0-mesons take up a large share of the energy in the case of inelastic events. The measurement of π^0-energy and the coefficient of inelasticity lead to excessive estimates of the initial particle energy. The integral spectrum of events caused by μ-mesons is exponential, with the exponent $\gamma = 2.22 \pm 0.14$. At sea level μ-mesons generate ~70% of all ionizing events having $\sim 2 \times 10^3$ relativistic particles, and about 50% in the case of events having $\sim 2 \times 10^4$ particles. (TTT)

27875 A CASE OF HIGH ENERGY NUCLEAR INTERACTIONS WITH ISOTROPIC ANGULAR DISTRIBUTIONS. K. I. Alekeeva, L. L. Gabuniya, Den-phen Su, G. B. Zhdanov, and M. I. Tret'yakova. Izvest. akad. Nauk S.S.S.R., Ser. Fiz., 26: 572-4(Apr. 1962). (In Russian)

A liter of emulsion was exposed at an altitude of 10 km for ~150 hours. An event was found which appeared to be caused by a 2×10^{12} ev primary, with the average secondary momentum of 0.4 Bev/c. The event was analyzed as isotropic, and interpreted as a case of an "excited core." The coefficient of inelasticity in the laboratory system is ~25%. (TTT)

27876 GENERATION OF THE ELECTRON-PHOTON COMPONENT BY INTERACTIONS OF PARTICLES WITH ENERGIES OF 10^{12}-10^{14} ev WITH LIGHT NUCLEI IN THE ATMOSPHERE. L. T. Baradzei, V. I. Rubtsov, Yu. A. Smorodin, M. V. Solov'yev, and B. V. Tolkachev (Lebedev Inst. of Physics, Moscow and Moscow State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 575-84(Apr. 1962). (In Russian)

The apparatus consists of ~0.2 m^2 of ion chambers with suitable absorbers interposed between layers. Energy spectra were measured for showers originating in the atmosphere and for cascades originated by nuclear-active particles in a block of graphite. Data are presented graphically, and the photon spectra display a characteristic break at 2 to 4×10^{12} ev. Indications are that a new process may be appearing at this energy. From the electromagnetic cascades the absorption of nuclear-active particles was found to vary from 148 ± 10 to 129 g/cm^2, for energies from 10^{12} to 5×10^{13} ev. The coefficient of inelasticity for nuclear-active particles was found to be relatively constant over a large energy region. Finally, the intensity of the primary radiation from 2×10^{11} to 2×10^{13} ev was found to be $N(E) = (600 \pm 150)(E \times 10^{-12})^{-1.7\pm0.15}$ $h^{-1}m^{-2}$ sr^{-1}. (TTT)

27877 SHOWERS CREATED BY NUCLEI WITH ENERGIES $\geq 5 \times 10^{10}$ ev/NUCLEON. A. A. Loktionov and Zh. S. Takibaev. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 596-603(Apr. 1962). (In Russian)

The results obtained for nuclear showers were compared with known data for nucleon-nucleon showers. In the collisions with the emulsion nuclei, high energy nuclei interact cylindrically. For the case of primary nucleons, the cylindrical model is applicable only at extremely high energies. The dependence of multiplicity on energy for showers created by nucleons and by nuclei is not the same for the two cases: for α-showers in the region of energies 5×10^{10} to 10^{13} ev/nucleon, $n_s \sim E^{0.15\pm0.02}$ to $E^{0.29\pm0.01}$ and $r_{s,\gamma}$ E = 0.65 to 0.95 whereas for nucleon-nucleon showers $n_s \sim E^{0.25}$ and $r_{s,\gamma}$ $\gamma_c \sim 0.3$. For nuclear showers $G \sim (0.066 \pm 0.008)$ log E/2M whereas for showers created by nucleons $G \sim (0.146 \pm 0.009)$ log E/2M. The difference cannot be explained by the dependence of angular distribution on the length of the cylinder. The angular distribution with two maxima for nuclear showers is possible only at energies $\geq 5 \times 10^{13}$ ev/nucleon. The coefficient of inelasticity for the case of central collisions of an α-particle with emulsion nuclei does not depend on energy; K = 0.4 to 0.6. The average value of N_h, which can serve as a good measure of excitation of target nuclei, is determined by the volume of the cylinder and is independent of the energy of the primary particle: $\overline{N}_h = (0.85 \pm 0.1)\, A_\alpha^* (e^* + 1)$ at $E > 5 \times 10^{10}$ ev/nucleon. The differences in the characteristics of showers created by nucleons and nuclei lead to the conclusion that nuclei-nuclei interactions are not the result of the superposition of individual nucleon-nucleon collisions. The results of this work lead one to assume that upon a collision of one nucleus with another, central nucleon-nucleon interactions are primarily involved. It can also be noted that dependences obtained for α-showers tend to go to known values for nucleon-nucleon showers as one goes from $e \geq 2$ to $e < 2$ and to quasi nucleon-nucleon interactions. (TTT)

27878 ANALYSIS OF SHOWERS FORMED BY HIGH-ENERGY COSMIC-RAY PARTICLES ON THE BASIS OF THE EXCITED NUCLEON MODEL. L. A. San'ko, Zh. S. Takibaev, and P. A. Usik. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 604-12(Apr. 1962). (In Russian)

Experimental determination of the angular distribution of excited nucleons serves as a method for obtaining information on the laws governing the interaction of neutrons in the very high-energy region. Use is made of the 2-center model which is based on the assumption that the 2 colliding nucleons excite each other to a certain isobaric state, resulting in an increase of mass after which they decay rapidly independently from each other, forming π-mesons and passing to the ground state. The study showed that the mass of the excited nucleons and thus the majority of the generated depend on the direction of the excited nucleons in the mass center system. If the emission centers consist of excited nucleons and the direction of their motion coincides with the axes of the shower cones, the excitation mechanism must be different from that taking place in single-meson interactions. The longitudinal component of the volume pulse plays a greater role in the excitation of the nucleon than the transversal component which determines the deflection angle of the nucleon. (TTT)

27879 STUDY OF THE DEPENDENCE OF THE AVERAGE ENERGY TRANSMITTED BY π^0-MESONS ON THE ENERGY OF THE PRIMARY PARTICLES IN THE 10^{11} TO 10^{12} ev REGION. S. A. Azimov, A. M. Abdullaev, V. M. Myalkovskii, and T. S. Yuldashbaev (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 613-17(Apr. 1962). (In Russian)

The coefficient of inelasticity K or the portion of the energy of a primary particle which is transferable in nucleon-nucleon collisions to secondary particles, is one of the most important characteristics of high-energy interactions but this dependence cannot be determined from available experimental data in the range beyond 10^{11} ev. This problem was studied in the 10^{11} to 10^{12}-ev range by means of Cherenkov counters, estimating the energy of the primary particles by a calorimetric method. The Cherenkov counters used consisted of vessels containing water, glycerine or gasoline and a second Plexiglas container with MgO. The energy transferred by the π^0-mesons was estimated from the number of relativistic particles in the electron-photon showers under a Pb layer while the coefficient of inelasticity was determined as the ratio of the π^0-mesons formed during the first portion of the nuclear interaction to the total energy of the primary particles. During the 850 hours of the test the device recorded 550 showers with energies higher than 50 Bev. The distribution curve K_{π^0} showed that transfer of more than 50% of the primary energy by neutral π mesons is very rare, less than 3%. The average value of the coefficient in the region beyond 10^{11} ev was (17 ± 1.5%). (TTT)

27880 THE NATURE OF THE ANGULAR DISTRIBUTION OF RELATIVISTIC PARTICLES IN α-NUCLEAR SHOWERS. A. P. Zhdanov and I. M. Kuks. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 618-21(Apr. 1962). (In Russian)

Attempts were made in the past to determine the homogeneity or the similarity of formation of "explosive" showers on the basis of their angular distribution (A. P. Zhdanov et al. Zhur. Eksper. i Teoret. Fiz., 39: 1177(1960)), showing that the angular distribution of nucleon-nuclear showers

represents a Gaussian curve; only an insignificant number of showers showed a different type of distribution. In 28 cases of inelastic interactions of α particles with the nuclei of the photoemulsion 3 cases could be distinguished: nucleon-nuclear type showers with Gaussian distribution; showers with Gaussian distribution having 1 or 2 strongly collimated particles in the direction of the primary α particle and showers the distribution curves of which indicated that they resulted from the superimposition of 2 Gaussian curves. The second case is similar to the first one, the highly collimated particle being considered as the proton of the primary α particle not undergoing a collision with the target nucleus. Determination of the particle distribution in the azimuthal direction φ in addition to the polar angle Θ indicate an as yet unresolved correlation between φ and Θ, being probably due to the conservation of the transversal pulse of the system. (TTT)

27881 THE PRIMARY COMPONENT OF COSMIC RADIATION IN THE SUPERHIGH ENERGY RANGE AND CERTAIN FEATURES OF ITS INTERACTION WITH THE ATOMS OF AIR. S. N. Vernov, G. B. Khristiansen, I. F. Belyaeva, V. A. Dmitriev, G. V. Kulikov, Yu. A. Nechin, V. I. Solov'eva, and B. A. Khrenov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 651-7(Apr. 1962). (In Russian)

For the last 3 years the extensive air showers created by superhigh-energy cosmic rays were investigated at the University of Moscow. The project makes use of charged-particle detectors, μ-meson detectors, and nucleon-active detectors displayed on an area of 4 hectars. The large number of charged-particle detectors made it possible to detect the spatial distribution of the flux density for a given shower from which the number N of the charged particles at the observed energy level E_0 could be calculated. No clear correlation could be derived between E_0 and N. Examination of the particle spectrum indicated an irregularity at $N \sim 10^6$; this was probably due to a corresponding irregularity in the energy spectrum of the primary cosmic rays. The μ-meson detectors allowed the presence of electromagnetic radiation and γ-quanta to be established. In the electron-photon avalanche μ-mesons may indeed appear as the result of the decay of $\pi^\pm$ mesons. For explaining the observed phenomena, it may be assumed that in 3% of the cases the nuclear interaction is accompanied by the generation of beams containing mostly $\pi^\pm$ mesons. The alternate explanation requires that in nuclear interaction occurring at superhigh energies ($E_0 \sim 10^{15}$ ev) a faster generation of μ mesons takes place as the result of the $\pi^\pm$ or $K^\pm$ meson decay. Further experiments are needed for choosing between these theories. (TTT)

27882 EXTENSIVE AIR SHOWERS FROM HIGH-ENERGY PHOTONS. I. F. Belyaeva, V. I. Solov'eva, B. A. Khrenov, and G. B. Khristiansen (Moscow State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 658-60(Apr. 1962). (In Russian)

Extensive air showers were discussed by R. Maze and A. Zawadski (Nuovo cimento, 17: 625(1960)) who found that the number of showers containing more than 10^6 particles at sea level is not more than 1% of the ordinary showers formed by protons and nuclei. It was attempted to determine experimentally the number of such showers. As the photon and the proton or heavy-nuclei showers differ primarily in the number of the penetrating particles they contain, the upper limit of the number of μ-mesons in photon showers with energies of $E \approx 10^{15}$ ev and $N = 10^7$ particles, was determined together with the spatial distribution of these mesons. Study of 126 extensive air showers with N between 4×10^6 and 2×10^7, recorded within a circle with a 100-m radius, did not reveal a single one with the expected meson ratio. This indicates with a strong probability that not a single electron-photon shower was among the recorded events. (TTT)

27883 STUDY OF THE SPECTRA OF HIGH-ENERGY μ-MESONS AT A DEPTH OF 40 M OF WATER EQUIVALENT. S. N. Vernov, V. A. Dmitriev, G. B. Khristiansen, and Gulyan Sadyk Mukhibi. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 661-7(Apr. 1962). (In Russian)

Investigation of the high energy μ-meson spectra which is expected to throw light on the origin of μ-mesons and the high-energy π-mesons generated in nuclear interactions, is complicated by the limitations of the magnetic spectrometers. It was therefore attempted to study these spectra in an underground location, using an instrument which allows the simultaneous measurement of μ-mesons with energies in the broad range of 10^{10} to 10^{13} ev. The device contained 2 sets of ionization chambers placed at a depth of 40-m of water equivalent, recording the meson spectrum in the form of ionization impacts caused by the high-energy μ-mesons. The chambers were shielded with a 16-cm thick Pb layer; an array of 48 Geiger-Müller counters were placed under the chambers. Threshold ionization events corresponding to 80 and 400 particles were determined. It was found that the energy spectrum of μ-mesons in the 10^{11} to 10^{13} ev range has a gradual character with an indicator of $\gamma = -1.9 \pm 0.2$. In the range of 10^{11} ev the spectrum has a steeper slope, possibly because of energy losses. In the 10^{11} to 10^{12} ev range the spectrum obtained agrees with those yielded by a magnetic spectrometer and beyond 10^{12} ev, with those derived from the angular distribution of μ-mesons by P. Barrett and L. Bollinger (Rev. Modern Phys., 24: 133(1952)). (TTT)

27884 HIGH-ENERGY NUCLEAR-ACTIVE PARTICLES AND ELECTRON-PHOTON AVALANCHES IN THE CORE OF EXTENSIVE AIR SHOWERS OF COSMIC RAYS. S. I. Nikol'skii, E. A. Murzina, E. I. Tukish, and V. I. Yakovlev (Lebedev Inst. of Physics, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 668-73(Apr. 1962). (In Russian)

The rather weak correlation between the spatial characteristics of extensive air showers and the observed height of the events indicates that processes in the vicinity of the core of the shower exert a great influence on their general behavior during passage through the atmosphere. Study of this phenomenon involves the simultaneous measurement of the number of particles, of the energy of nuclear-active and electron-photon components in the core of the individual showers. For the experimental work a large assembly with a surface of 25-m^2 was used; it consisted of 4 series of ionization chambers placed under absorbers and hodoscopic counters and was used for determining the flux density in air. The data obtained during 1959 in the Pamir Mountains do not allow conclusions to be drawn concerning the number of particles in the extensive air showers from the energy of the nuclear-active particles, even when they are primary ones. As a result of the change of the nature of the elementary process at energies beyond 10^{14} ev or because of the increase of the α-particles and of heavier nuclei in the composition of the primary cosmic radiation at that energy level, no energetically separate nuclear-active particles can be found in showers containing a large number of particles. (TTT)

27885 THE ANGULAR DISTRIBUTION OF THE PENETRATING COMPONENT OF EXTENSIVE AIR SHOWERS AT A DEPTH OF 200 METER WATER-EQUIVALENT. E. L. Andronikashvili, M. F. Bibilashvili, G. D. Vardenga, T. V.

Gvaladze, A. K. Dzhavrishvili, R. E. Kazorov, R. V. Kuridze, and I. V. Khaldeeva. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 682-4(Apr. 1962). (In Russian)

The results of experiments which were conducted for the purpose of explaining certain observed divergencies in the measurements of the angles of inclination of penetrating particles in extensive air showers (EAS) are reported. Previously it was not possible to confirm the coincidence of the angular distribution of the axis of the EAS and of the μ mesons which form a part of the structure of these showers. The angular distribution of the EAS was measured in the usual manner on the surface of the earth with an arrangement of hodoscopes and specialized equipment. The spatial distribution of the penetrating component was determined underground at a depth of 200 meter water equivalent in the field of a 6-power telescope interlaid with lead of a general thickness of 25 cm. With the telescope it was possible to project the angles of inclination of the penetrating component into mutually perpendicular planes, the maximum of which was $370^0 \pm 4^0$. The results of these experiments were derived from a total number of 10^5 to 10^6 particles in the EAS at a height of 400 meters above sea level. Histograms are shown of the angular distribution of the EAS based on 112 observations and of the spatial angles of the penetrating component in 312 cases of observations of projected angles. The exponent in the cosine law of angular distribution of penetrating particles having energies in excess of 40 bev as determined from the spatial angles of the EAS is equal to $8.6^{+2.2}_{-1.6}$, while in the case of the penetrating components, based on projected angles, the exponent was found to be $7.5^{+1.6}_{-1.1}$. These exponents are in satisfactory agreement with the results of estimated calculations. (TTT)

27886 THE NATURE OF THE PRIMARY COMPONENT OF COSMIC RAYS IN THE REGION OF HIGH ENERGIES AND EXTENSIVE AIR SHOWERS. N. N. Goryunov, L. G. Dedenko, and G. T. Zatsepin. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 685-8(Apr. 1962). (In Russian)

An analysis was made of experimental facts concerning extensive air showers which occurred in the Pamir Mountains and that were observed at Moscow University and in Japan. From these observations it was concluded that the energy of primary particles is equivalent to $E_o = 3 \times 10^{15}$ ev. It is proposed that for showers with a low-energy spectrum the exponent $\gamma = 1.7$, whereas for higher energies $\gamma = 2.2$, a change of 0.5. Explanations are given concerning the relationship of energy spectrum and composition of primary components of cosmic rays in this Galaxy, indicating that such may be limited by two factors, depending upon the source of the rays and on the accumulation of a wide variety of particles in the Galaxy. A study was made of the scatter ratio E/N of a large number of energy spectra. An explanation of the extremely wide fluctuations which are observed when $N < 10^5$ is presented. The evidence indicated a predominance of heavy nuclei in the regions of high energy. (TTT)

27887 STUDY OF THE HIGH-ENERGY μ-MESON FLUXES IN EXTENSIVE AIR SHOWERS AT SEA LEVEL. B. A. Khrenov (Moscow State Univ.). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 689-91(Apr. 1962). (In Russian)

The μ-meson component of extensive air showers was investigated during the years of 1958 to 1960 at depths of 20 and 40 m underground, determining their spatial distribution, their ratio to the total number of particles and their flux density spectrum. The measurements were carried out by means of a hodoscope containing a large array of G-M tubes. The spatial distribution of μ-mesons with $E \geq 10$ Bev thus obtained does not agree with data reported by E. L. Andronikashvili et al., (Zhur. Eksper. i Teoret. Fiz., 32: 403 (1957)); the divergence might be due to an error in measuring the number of particles. From the absolute μ-meson flux the μ-meson spectrum could be determined. The total energy of the μ-mesons with an energy $E \geq 5$ Bev in a shower having $N = 10^6$ particles was calculated as 7.2×10^{15} ev or about 7% of the energy of the primary particles. (TTT)

27888 APPLICATION OF THE KOLMOGOROV–DMITRIEV METHOD FOR CALCULATING NUCLEAR CASCADES. N. N. Kalmykov. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 692-6(Apr. 1962). (In Russian)

Study of the fluctuations of the number and of the flux of the nuclear-active particles in the core of extensive air showers is of great interest because it yields information concerning the nuclear interactions taking place at superhigh energies. The experimental work was carried out by using the method developed by A. N. Kolmogorov and N. A. Dmitriev (Doklady Akad. Nauk SSSR, 56: 7(147)). Calculations based on the data obtained indicate that the nucleon transfers all of its energy to a π-meson. Charged π-mesons constitute $^2/_3$ of the overall number of the generated particles; their energy spectrum may be determined from Landau's theory. One of the secondary particles carries away 50% of the energy; with $^1/_3$ probability this particle is a π^0-meson; with $^2/_3$ probability a charged meson. The dispersion of the number of particles in a given energy range was found to be normal. (TTT)

27889 THE LATERAL DISTRIBUTION OF THE ČERENKOV RADIATION IN EXTENSIVE AIR SHOWERS. K. Sitte. Nuovo cimento (10), 25: 86-103(July 1, 1962). (In English)

The lateral distribution of the Cherenkov radiation is calculated for showers of various zenith and azimuthal angles. No single structure function can be defined; for inclined showers, the intensities decrease outwards much more rapidly than for vertical events. For nonvertical showers, the distribution is also eccentric and asymmetrical. The intensity maximum always lies in the direction of the shower axis, but at some distance from the shower core. At a zenith angle of 20°, for instance, the maximum is displaced by about 20 m. The analysis of the relative contributions from various altitudes shows that those levels generally are the most effective at which the shower core first reaches the field of vision of the detector; where the core is not seen, the contributions tend to decrease uniformly with increasing altitude. Calculations are compared with data, and their implications for the technique of night-sky Čerenkov light experiments are discussed. (auth)

27890 ANGULAR DISTRIBUTION OF JETS PRODUCED BY HEAVY PRIMARY COSMIC-RAY NUCLEI. E. Balea, E. M. Friedlaender, C. Potoceanu, and M. Sahini (Inst. of Atomic Physics, Bucharest). Proc. Indian Acad. Sci., Sec. A, 55: 367-92(June 1962). (In English)

A statistical method was developed for analyzing the angular distribution of meson jets produced by heavy primary cosmic-ray nuclei, enabling detection and elimination of the proton jet due to evaporation of the residual incident nucleus. The procedure was applied to 50 high-energy collisions of heavy primary nuclei. It is shown that a significant fraction of the heavy primaries produced bi-modal meson jets consistent with the two-center model. (auth)

27891 SEMIDIURNAL VARIATION OF COSMIC RAYS ON GEOMAGNETICALLY DISTURBED DAYS. H. S. Ahluwalia (Physical Research Lab., Ahmedabad, India). Proc. Phys. Soc. (London), 80: 472-8(Aug. 1, 1962).

A statistical study is made of the semidiurnal variation of the intensity of cosmic rays on geomagnetically dis-

turbed days. This study is based on nucleonic component data obtained at the equatorial stations of Ahmedabad and Huancayo, during 1957 and 1958. The planetary character figure C_p is used as an index of geomagnetic activity. It is shown that the low average amplitude of the semidiurnal variation observed on geomagnetically disturbed days, compared with geomagnetically quiet days, results primarily from the large variability of the time of maximum of the semidiurnal variation on disturbed days. The individual amplitudes of the semidiurnal variation on geomagnetically disturbed days are comparable with those on quiet days. This result constitutes evidence that the semidiurnal variation of the intensity of cosmic rays, at equatorial stations, is of extra-terrestrial origin. It is suggested that any theory that seeks to explain the origin of the solar daily variation of cosmic rays must take account of semidiurnal as well as diurnal variations. (auth)

27892 HIGH-ENERGY SOLAR-PARTICLE EVENTS. Hugh Carmichael (Atomic Energy of Canada Ltd., Chalk River, Ont.). Space Sci. Rev., 1: No. 1, 28-61(June 1962).

High-energy solar-particle events are illustrated and described individually. The manner in which the observations are used to develop and test concepts of the hydromagnetic behavior of the solar plasma in space is outlined. The results seem to support the concept that the magnetic field of a sunspot tends to erupt, or to balloon, into space in the form of a great tongue or sack attached to the sun near the sunspot. Supersonic shock processes also must be involved in the propagation of disturbances in planetary space, and the fluxes of galactic and of solar particles may change in the vicinity of such shocks, but shocks alone do not appear to be capable of explaining all the observed effects. (auth)

27893 DYNAMICS OF THE GEOMAGNETIC STORM. E. N. Parker (Univ. of Chicago). Space Sci. Rev., 1: No. 1, 62-99(June 1962).

Ideas concerning the mechanisms responsible for the geomagnetic storm are reviewed. The dynamical theory of the geomagnetic storm phenomenon is formulated as a problem in elasticity. The observed variations in the field are the strains produced by particle stresses exerted by gases in interplanetary space, by gases enmeshed in the field, and by the gases in the ionosphere. The stresses exerted by interplanetary gases are principally inward, resulting in the initial phase increase of the horizontal component. The stresses exerted by gases enmeshed in the field are principally outward, resulting in the main phase decrease of the horizontal component. The transient sudden commencement is a hydromagnetic wave phenomenon. The main phase is most simply explained by the shock heating of the ions to kev energies at 3 to 5 R_E during the active phase of the storm. The recovery follows then from charge exchange with the ambient neutral hydrogen. The predicted increase in recovery rate at sunspot minimum is verified observationally. (auth)

27894 MAGNETIC STORMS. T. Gold (Cornell Univ., Ithaca, N. Y.). Space Sci. Rev., 1: No. 1, 100-14(June 1962).

Solar chromospheric outbursts propagate various disturbances to the earth. Among these influences are electromagnetic waves, high-energy particles, shock waves, and the solar wind. The roles played by each of these factors in the production and behavior of geomagnetic storms are considered. Attention is devoted to the solar explosions themselves, the propagation of the disturbances through interplanetary space, the effects of these disturbances on cosmic ray intensities on earth, interactions in the vicinity of the earth, and mechanisms for imbedding hot plasma in the earth's magnetosphere. (T.F.H.)

27895 THE POLAR CAP ABSORPTION EFFECT. D. C. Rose and Syed Ziauddin (National Research Council, Ottawa). Space Sci. Rev., 1: No. 1, 115-34(June 1962).

Techniques for observing polar-cap absorption (PCA) events are outlined. The characteristics, time sequences, associated solar-terrestial phenomena, and effects of geomagnetic storms on PCA events are reviewed. The height of the absorbing region during the PCA event is considered. Solar radio emission during a Type-IV radio outburst is investigated, and the natures and spectra of solar particles that may be associated with PCA events are examined. The emission and interplanetary storage of solar protons is considered. The relations between PCA events and other solar-terrestial effects are studied. (T.F.H.)

27896 PROTON STORMS IN INTERPLANETARY SPACE. COSMIC AND SOLAR PARTICLE RADIATION PROBING INTERPLANETARY EVENTS. G. Pfotzer (Max-Planck-Institut fur Aeronomie, Lindau a. Harz, Ger.). Umschau Forschr. Wiss. u. Tech., 62: 197-201 (Apr. 1, 1962). (In German)

It is shown how one can derive from seemingly contradictory measurement results a model for certain processes in interplanetary space which manifest themselves in oscillations in cosmic radiations, the earth's magnetic field, and ionospheric currents in the same manner as weather development at the earth's surface is manifested by barometric changes. The possible hazards to future space travel from proton storms were reviewed. (J.S.R.)

Criticality Studies

27897 (HW-SA-2622) OPERATING EXPERIENCE IN THE HANFORD PLUTONIUM CRITICAL MASS FACILITY. R. C. Lloyd, E. D. Clayton, and W. A. Reardon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 8, 1962. Contract [AT(45-1)-1350]. 17p.

Information on operating experience is given along with a description of equipment and flow diagrams for solution handling. A schematic of the critical assembly room, a mixing, change, equipment, and control room is also included. Contamination control is discussed. (J.R.D.)

Elementary Particles and Radiations

Refer also to abstract 27365.

27898 (CTSL-34) A NOTE ON THE LEPTONIC DECAYS OF THE K-MESON. David H. Sharp and William G. Wagner (California Inst. of Tech., Pasadena. Synchrotron Lab.). June 21, 1962. Contract AT(11-1)-68. 9p.

An analysis of the leptonic decay modes of the K meson is presented in terms of a four-parameter representation of the two form factors $F_1(q^2)$ and $F_3(q^2)$, which describe the matrix element of the vector current of the weak interactions, $(\pi\,|V_\alpha|\,K)$. Such a representation, while general enough to take account of the violation of the $\Delta I = \frac{1}{2}$ rule and the possible existence of two resonances in the K-π system, no longer permits unique predictions for the ratio of the electron to muon decay rate, or of the pion spectrum. Various treatments of this problem, which have appeared,

are obtained as special cases of the present treatment. (auth)

27899 (DOFL-TR-1058) EXTRAPOLATION OF THE ELECTROMAGNETIC FIELD. John S. Wicklund (Diamond Ordnance Fuze Labs., Washington, D. C.). July 2, 1962. 9p.

Given the shape of a pulse of electromagnetic radiation at a known distance from the source, an analytic expression was derived in the electric dipole approximation that yields the shape of the pulse at any other point. The technique uses the observed signal as a forcing function to obtain a Green function solution of the differential equation for the time behavior of the dipole moment. The result is useful as a check on machine computation and in those cases where the use of an analog computer is impractical. (auth)

27900 (JINR-D-958) ON WEAK INTERACTION THEORY. M. A. Markov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 7p.

Possibilities are considered concerning formulations of the limitations for four-fermion weak interactions leading to observable forbiddennesses. (J.R.D.)

27901 (JINR-E-945) EFFECT OF PAIRING CORRELATIONS OF THE SUPERCONDUCTIVE TYPE ON THE ALPHA DECAY RATES. V. G. Solov'ev (Soloviev) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 8p.

A discussion is presented in which the theory of the alpha decay is formulated in the framework of the superfluid nucleus model, and the influence of the pairing correlations of the superconductive type is investigated in the areas of alpha decay absolute probability and hindrance factors (F). (J.R.D.)

27902 (JINR-E-961) SIMPLE APPROACH TO THE DETERMINATION OF REGGE-POLES. G. Domokos (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 4p.

A procedure is sketched for determination of Regge-Poles. Efforts will be made to extend the procedure to a method of obtaining Regge-trajectories. (J.R.D.)

27903 (JINR-E-994) LOW-ENERGY PION-PION SCATTERING. A. V. Efremov, V. V. Serebryakov, and D. V. Shirkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics).

Equations for low-energy pion-pion scattering were studied. The imaginary parts of partial-wave amplitude on the unphysical cut are defined from the approximate crossing-symmetry condition corresponding to the forward scattering. The s-wave model for the neutral pion scattering was examined. Results from these equations and from experimental data were compared. (M.C.G.)

27904 (JINR-E-998) REGGE-POLES AND FORM FACTORS. G. Domokos and J. Wolf (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 4p.

It is shown that by slight modification of the resonance approximation for form factors, experimental data on form factors can be used to determine Regge-trajectories. (M.C.G.)

27905 (JINR-P-871) ZAMECHANIYA O SOOTNOSHENII PROBEG-ENERGIYA. (Notes on the Relationship Range-Energy). To Ying Seb (Joint Inst. of Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1962. 13p.

The range of charged heavy particles in matter can be expressed in terms of universal function with a good accuracy. By means of this function the range-energy ratio can be represented as $E = \alpha R^m$, where m is independent of the matter composition. (auth)

27906 (NASA-TN-D-1343) NONADIABATIC THEORY OF ELECTRON-HYDROGEN SCATTERING. A. Temkin (National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.). July 1962. 32p.

A rigorous theory of the s-wave elastic scattering of electrons from hydrogen is presented. The Schrödinger equation was reduced to an infinite set of coupled two-dimensional partial differential equations. A zeroth order scattering problem was defined by neglecting the coupling terms of the first equation. An exact relation was derived between the phase shift of this zeroth order problem and the true phase shift. The difference between these was given by a rapidly convergent series whose terms correspond adiabatically to multipole distortions of the hydrogen by the incoming electron. Recognition of the physical significance of the zeroth order problem is considered basic to the understanding of the scattering problem. The exchange approximation for s-wave scattering is shown to be a variational approximation of the zeroth order problem. A perturbation theory was introduced to calculate the higher order corrections. The dipole correction had an increasingly important quantitative effect in the limit of zero energy. The effect of the long range part of this correction on the scattering length can be expressed by a formula in terms of inverse powers of a long range parameter R. Phase shifts were calculated for both singlet and triplet scattering, including up to quadrupole terms. The convergence was such that this number of terms should yield better than four place accuracy. Uncertainties in the calculated values decreased the accuracy to approximately three significant figures. (auth)

27907 (NP-11633) NARUSHENIE PRAVILA $\Delta Q = \Delta S$ V LEPTONNYKH RASPADAKH I POVEDENIE SLABYKH VZAIMODEISTVII PRI BOL'SHIKH ENERGIYAKH. (Disturbance of the $\Delta Q = \Delta S$ Rule in Lepton K-meson Decay and the Behavior of Weak Interactions at High Energies). B. L. Ioffe (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eskperimental'noĭ Fiziki). 1962. 6p.

It was previously postulated that in K^0 lepton decay the rule $\Delta Q = \Delta S$ does not hold, and in addition to $\Delta Q = \Delta S$ permitted decay, $K^0 \rightarrow \pi^- + e^+ + \nu$, the K^0 decays also by $K^0 \rightarrow \pi^+ + e^- + \bar{\nu}$. Moreover, the probabilities of both decays are about equal. It is postulated that $\bar{K}^0$ also should decay by $\bar{K}^0 \rightarrow \pi^+ + e^- + \bar{\nu}$ and $\bar{K}^0 \rightarrow \pi^- + e^+ + \nu$, and consequently $K^0 \rightarrow \bar{K}^0$ takes place as an interaction chain, $K^0 \rightarrow \pi^+ + e^- + \bar{\nu} \rightarrow \bar{K}^0$ or $K^0 \rightarrow \pi + e^+ + \nu \rightarrow \bar{K}^0$. An analysis is made of the matrix transition $K^0 \rightarrow \bar{K}^0$. (tr-auth)

27908 (NP-11634) POISKI $\mu^+ \rightarrow e^+ + e^+ + e^-$. (A Search for the Decay $\mu^+ \rightarrow e^+ + e^+ + e^-$). A. I. Babaev, M. Ya. Balatz, V. S. Kaftanov, L. G. Landsberg, V. A. Lyubimov, and Yu. V. Obukhov (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki). 1962. 11p.

A search was made for the $\mu \rightarrow 3e$ process using an installation previously used by A. I. Alikhanov, et al. (Z. Eksp. i Teoret. Fiz. v. 42, No. 6, 630, 1962). The installation for recording $\mu^+ \rightarrow e^+ + e^+ + e^-$ consisted of a six-layer cylindrical spark chamber, a single-layer plane spark chamber, a camera, a mirror, and series of scintillation counters. The Dalitz diagram was used for determining the recording efficiency. After 70 hours, 6.96×10^9 meson stops were recorded, however, none could be considered $\mu^- \rightarrow 3e$ according to formulated criteria. The anticipated number of $\mu \rightarrow 3e$ decays was $M = \rho N_\mu \epsilon f$ (where ρ is the probability of $\mu \rightarrow 3e$ decay in relation to ordinary

decay, $N_\mu = 6.98 \times 10^8$, ϵ is the efficiency of the installation = 0.0165, f is a correction factor = 0.76. Calculations made with the Poisson formula show $\rho_{\mu \to 3e} < 2.6 \times 10^{-7}$ (with 90% accuracy), considering matrix elements constant; with corrections for efficiency, $\rho_{\mu \to 3e} < 2.0 \times 10^{-7}$. (R.V.J.)

27909 (NP-11775) SOME CONSEQUENCES OF THE MOVING POLE HYPOTHESIS FOR HIGH ENERGY PROCESSES. V. N. Gribov (Akademiya Nauk S.S.S.R. Fiziko-Tekhnicheskii Institut) B. L. Ioffee, I. Ya. Pomeranchuk, and A. P. Rudik (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1962. 8p.

Also published in Zhur. Eksptl'. i Teoret. Fiz., 42: 1419-21(May 1962).

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 22960.

27910 (NP-11839) SOME CORRECTIONS TO PARTIAL WAVE DISPERSION RELATIONS FOR PION PHOTOPRODUCTION (thesis). Technical Report No. 38. John McKeen McKinley (Illinois. Univ., Urbana). May 1962. Contract ONR 1834(05). 158p.

The exact one dimensional dispersion relations for partial wave amplitudes of pion-nucleon scattering and of pion photoproduction on nucleons were derived and compared. It was found that a non-constant comparison function must be introduced into the relationship between the scattering partial wave amplitude which is dominant at low energies and the corresponding photoproduction partial wave amplitude, in order that each amplitude obey its own exact dispersion relation at the same time that the two amplitudes are related by the unitarity condition. The results of experimental determinations of pion-nucleon scattering phase shifts were compiled, and the coefficients of interpolation formula for the phase shifts were evaluated. Two sets of interpolation formula were found, one of which attempts to incorporate all experiments while the other disregards three intermediate-energy experiments which do not appear to follow the trend of the other experiments. The experimental results of photoproduction of neutral and positive pions on protons at energies up to 500 Mev were compared to calculated cross sections for various phase shifts and inclusion of the comparison function. There was no overwhelming indication either for or against the inclusion of the comparison function. The photoproduction cross sections were also calculated with the inclusion of the bipion. The effect of this contribution was generally greater than the effect of either the comparison function or a change of phase shifts. On the basis of the π^+ angular distribution it appeared that the coupling parameter for this contribution should be negative. (auth)

27911 (NYO-10036) THE NUCLEON-NUCLEON INTERACTION AT ABOUT 210 Mev. A SURVEY OF THE RESULTS AND ANALYSIS OF SCATTERING EXPERIMENTS PERFORMED AT ROCHESTER. John Tinlot (Rochester, N. Y. Univ.). Jan. 24, 1962. Contract [AT (30-1)-875]. 36p.

A discussion is presented of the latest p-p and quasi-elastic p-n scattering results at 210 Mev. It is noted that the p-p study is more advanced and more data are available for presentation. The discussion includes comment on formalism, methods of p-p experiments, and results. Other comment is included on experimental difficulties, and conclusions. Tabulated data and illustrations are also included. (J.R.D.)

27912 (NYO-10232) SOME CONSEQUENCES OF ANALYTICITY AND UNITARY CONDITIONS IN SCATTERING PROBLEMS. (I). Susumu Okubo (Rochester, N. Y. Univ.). May 18, 1962. Contract AT(30-1)-875. 57p.

Some consequences based upon the Mandelstam representation and the unitarity condition were examined. Some conditions for the validity of the Mandelstam representation are given, and the question of the analytic continuation of the scattering phase-shifts into the complex angular momentum was investigated. As an application, a theorem which is a certain generalization of results of Froissart and of Goebel about the high-energy behavior of the total cross section was given. (auth)

27913 (NYO-10235) A STATISTICAL MODEL, INCLUDING NEW PARTICLE RESONANCES, AS APPLIED TO $\bar{\Lambda}$-p ANNIHILATION. M. E. Arons (Rochester, N. Y. Univ.). June 12, 1962. Contract AT(30-1)-875. 23p.

A form of the covariant statistical model that utilizes final state meson resonances is discussed and applied to annihilation. For that reaction, numerical values for the average pion multiplicity and relative 3K production are calculated under several assumptions. (auth)

27914 (UCRL-10175) K^--PROTON INTERACTIONS NEAR 400 Mev/c (thesis). Mason B. Watson (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1962. Contract W-7405-eng-48. 109p.

Elastic and charge-exchange scattering as well as hyperon production by K^- mesons on protons are reported for a range of momenta near 400 Mev/c. Differential and total cross sections for all channels from 200 to 513 Mev/c are examined. For $\Sigma^+\pi^-$, $\Sigma^0\pi^0$, and $\Lambda\pi^0$ production, polarization measurements are also available. A resonant state of mass 1520 Mev (390 Mev/c $\bar{K}$ momentum) was found with components $\bar{K}N$, $\Sigma\pi$, and $\Lambda\pi\pi$. The resonance is found to have a full width, Γ, of approximately 15 Mev, spin $^3/_2$, isotopic spin 0, and parity that of the $\bar{K}$-N D_{3_2} state. By use of the polarization arising from the resonant D_{3_2}-amplitude–s-wave interference the KPΣ parity is determined to be odd. The data between 350 and 450 Mev/c are fitted to a model based on a Breit-Wigner resonant amplitude and zero-effective-range nonresonant amplitudes. Two solutions differing principally in the p waves are found. The s-wave parameters are found to agree quite well with the Humphrey-Ross values except for the relative phase in the $\Sigma\pi$ channel. (auth)

27915 (UCRL-10254) REGGE POLES AND ASYMPTOTIC BEHAVIOR IN THE ANALYTIC CONTINUATION OF THE PION-NUCLEON SCATTERING AMPLITUDE (thesis). Virendra Singh (California. Univ., Berkeley. Lawrence Radiation Lab.). May 23, 1962. Contract W-7405-eng-48. 64p.

The pion-nucleon scattering amplitude and its analytic continuation $\pi + \pi \to N + \bar{N}$ were studied from the point of view of the analyticity in the complex angular momentum J plane. The quantum numbers that characterize the Regge trajectories are thereby settled. They are in the $\pi + N$ scattering channel, baryon number = 1, isospin = $^1/_2$ or $^3/_2$, J parity = even or odd, space parity = even or odd for Regge poles; and, for the $\pi + \pi \to N + \bar{N}$ channel, baryon number = 0, G-parity = +1, isospin = 0 or 1, J-parity = even or odd, space parity = even or odd. It turns out that in the $\pi + \pi \to N + \bar{N}$ channel, only the amplitudes having the same J parity and space parity, which is even for isospin 0 and odd for isospin 1, are nonvanishing. Experimentally observed particles and resonances are also discussed in terms of the Regge trajectories with definite quantum numbers, and certain experimental consequences pointed out. Expressions are also given for the experimental cross section in forward and backward scattering

cones for πN scattering. A discussion of the rigorous Froissart-type upper bounds on asymptotic behavior and their implications for undetermined single spectral functions is presented, which should be useful in any further work on the determination of the meromorphy domain in the J plane of the various partial-wave amplitudes. (auth)

27916 (AEC-tr-5234) INVESTIGATION OF TRANSITION RADIATION (thesis). S. Mikhalyak (Moscow State Univ.). (translation). 1961. 12p.

Electromagnetic radiation (transition radiation) appears when a charged particle crosses the boundary of one medium (vacuum) and passes in the other (metal). This Franck-Ginsberg theory is confirmed by examining the properties and characteristics of transition radiation from aluminum, nickel, and silver in the electron energy region of 6 to 70 kev. The transition radiation is measured in the visible region of the spectrum. The transition radiation energy for silver is 76.3%, aluminum 71%, and nickel 55.4% in comparison with an ideal conductor of 100%. Thus, transition radiation produced by electrons at the surface of a metallic target placed in a vacuum is accompanied by side effects; they make a definite, although slight, contribution to the total intensity of the measured radiation. (N.W.R.)

27917 (FTD-TT-62-378) THE COLLISION INTEGRAL OF CHARGED PARTICLES IN A MAGNETIC FIELD. V. M. Yeleonskii (Yeleonskiy), P. S. Zyryanov, and V. P. Silin. Translated from Fiz. Metal. i Metalloved., 11: 955-7(1961). 6p.

The collision integral for charged nonrelativistic particles in a homogeneous magnetic field is derived. Equations are given for the case where charged particles are scattered by each other, as well as the case where electrons are scattered by stationary impurities. The shielding of the charged particle field is taken into account systematically. This is done with the aid of the tensor of the complex permittivity of the medium. Since the permittivity gives a measure of the delay, one is compelled to use the theory of radiation in calculating the scattering probability. (N.W.R.)

27918 (JPRS-14370) STRONG INTERACTIONS — NEW DEVELOPMENTS IN ELEMENTARY PARTICLE RESEARCH. A. I. Alikhanov. Translated from Pravda, 4(May 25, 1962). 9p.

A review of Soviet developments in elementary particle research is presented. The emphasis in the review is placed on strong interactions research in progress at the Theoretical and Experimental Physics Institute. The status of accelerators at the Institute is reviewed along with plans for construction of larger units. (J.R.D.)

27919 ASYMMETRY IN THE ANGULAR DISTRIBUTION OF THE NEUTRONS EMITTED IN THE μ^-- MESON CAPTURE PROCESS IN CALCIUM. W. S. Yeffseyev, W. I. Komarov, W. Kusch, W. S. Roganov, W. A. Tchernogorova, and M. Szymczak (Joint Inst. for Nuclear Research, Lab. of Nuclear Problems, Dubna, USSR). Acta Phys. Polon., 21: 313-27(Apr. 1962). (In English)

The asymmetry in the angular distribution of neutrons emitted in μ^- capture in calcium was measured by the method of spin precession in the magnetic field. The value of the asymmetry coefficient was $A = -(0.066 \pm 0.022)$. The value and sign of the asymmetry coefficient indicate that the ratio of the constant of the induced pseudoscalar to that of the axial-vector interaction g_p/g_A has a positive sign and a value in excess of that predicted theoretically. (auth)

27920 SELECTION RULES IMPOSED BY THE SYMMETRICAL SAKATA MODEL. C. Iso (Brandeis Univ., Waltham, Mass.). Ann. Phys. (N. Y.), 19: 314-22(Aug. 1962).

New selection rules for strangeness nonzero systems based on a symmetrical Sakata model are discussed. New operators, $G_{\Lambda p}$, (exchange of Λ and p) × (charge conjugation), and $G_{\Lambda n}$, (exchange of Λ and n) × (charge conjugation), are defined. It is shown that in some systems these operators define good quantum numbers and that new selection rules are found. These selection rules are applied to the processes $K^{0*} \rightarrow K^+ + \pi^-$, $\bar{\Lambda} + p \rightarrow K^+ + K^+ + \bar{K}^-$ etc. Some processes are useful for checking these selection rules. (auth)

27921 THE PROBLEM OF THE PERIODIC ORBITS IN RESTRICTED RELATIVITY OF A POINT PARTICLE IN PLANE MOTION. Alberta Roveri. Atti accad. sci. Torino. I. Classe sci. fis., mat. e nat., 95: 214-20(1961-62). (In Italian)

It is shown that a force of the type $F = -\frac{1}{m}$ grad V(x,y) (m is Maupertuisian mass) makes periodic orbits possible in the plane for a point particle possessed with relativistic energy (between which one minimizes effectively the Maupertuisian action interval), provided the function V(x,y) satisfies expressly allowed conditions. (tr-auth)

27922 ANGULAR INFORMATION IN THE NUCLEON-NUCLEON COLLISION AT ULTRA RELATIVISTIC ENERGY. I. THE TRANSVERSE MOMENT AT 27 Bev. C. Castagnoli and I. Ortalli (Università, Turin). Atti accad. sci. Torino. I. Classe sci. fis., mat. e nat., 96: 417-29(1961-62). (In Italian)

The methods of angular information on nucleon-nucleon collisions at relativistic energies are of importance because they are not confined to the limitations imposed on methods of direct measurement during energy increase. But these methods have not been completely verified and have not always been completely discussed and exploited. By the introduction of a new method of kinematic information, the transverse moment of products produced by 27-Bev protons is studied. The results obtained with this new angular formula are compared with those obtained from direct measurement and good agreement is found. The method can be extensively applied to the case of jets with primary energy not directly measured. A good agreement with direct measurement is also found in this case. The validity of the method is almost proved, but the validity limits were not discussed. It was observed that the transverse moment increases with increase of primary energies. (tr-auth)

27923 DECAY OF A HYPERFRAGMENT WITH UNUSUALLY HIGH CHARGE. Maria Grazia Barbetta and Carlo Depietri (Università Modena, Italy). Atti soc. nat. e mat. Modena, 92: 1-7(1961). (In Italian)

A charged particle, ejected from a cosmic star of type 9 + 9p, decays at rest after a range of 6 μ into five charged particles. The event is explained as the non-mesic decay of a hyperfragment with $Z \geq 7$. (auth)

27924 HYPERFRAGMENTS PRODUCED BY π^- MESONS OF 17 Bev/c IN THE NUCLEI OF IONOGRAPHIC EMULSIONS. Germain Baumann, Henri Braun, and Pierre Cueer. Compt. rend., 254: 3839-41(May 28, 1962). (In French)

The first 44 hyperfragments obtained in the interaction of π^- mesons of 17 Bev/c were analyzed. Some rare events as well as a hyperfragment of charge Z = 9 were found. One event with a particularly high balance appears to be due to the ϵ^--nuclear bonding. (tr-auth)

27925 THE PRODUCTION AND INTERACTION OF STRANGE PARTICLES PRODUCED BY 1.0–1.1 Bev π^-

MESONS IN A XENON BUBBLE CHAMBER. Raphael Aaron Burnstein (Univ. of Michigan, Ann Arbor). Dissertation Abstr., 22: 1221(Oct. 1961).

A study was made whose purposes were: to measure the absolute cross sections for various strange particle production reactions in xenon; to present corrected momentum and angular distributions of the strange particles as observed in the laboratory; and to observe the interactions of neutral K mesons that resulted in hyperon production. This investigation made use of a xenon bubble chamber as the charged particle detector. In addition to identifying events, other parameters necessary for a cross section determination were measured. The associated production of two strange particles was required for the identification of an event. This requirement eliminated possible background effects. At a negative pion kinetic energy of approximately 1.0 Bev, $4.6 \pm 0.5 \times 10^6$ centimeters of pion track were scanned. Thirty-nine uncorrected events were observed where a lambda hyperon and neutral K meson were produced and both observed to decay in the charged mode. The cross section for the production of lambda and neutral K mesons was 7 ± 1 millibarns (per xenon nucleus). Results for other reactions were presented. At a negative pion kinetic energy of approximately 1.1 Bev, $5.5 \pm 0.5 \times 10^6$ centimeters of pion track were scanned. Seventy-two uncorrected events of the same lambda, neutral K reaction were found. The cross section for the production of lambda and neutral K mesons was 13 ± 2 millibarns (per xenon nucleus) at this higher beam energy. Corrected momentum and angular distributions based on fifty-seven uncorrected events of the same reaction at the lower beam energy were given. The corrected distributions were given for ninety-three uncorrected events of the same reaction at the higher beam energy. Nine examples were found of a neutral K meson interacting in the bubble chamber to produce a lambda, which decayed in the charged mode. Associated with the production of the original K^0 was a lambda. The total number and spatial distribution of these events were studied.

27926 DETERMINATION OF THE Λ^0 DECAY PARAMETER, α. James Dyke van Putten, Jr. (Univ. of Michigan, Ann Arbor). Dissertation Abstr., 22: 1222(Oct. 1961).

The parameter α is a measure of parity non-conservation in the Λ^0 decay. α is defined in terms of the complex amplitudes of the S and P orbital angular momentum waves in the decay. The decay mode $\Lambda^0 \rightarrow p + \pi^-$ is observed in a xenon bubble chamber. α is determined from the asymmetric scattering of the decay protons by xenon nuclei. Seven hundred and forty one lambda decays are observed. There are 113 nuclear scatterings. From this sample, α is found to be negative with a probability of 77%. The large error in the result is attributed to: the inclusion of inelastic scatterings in the scattering sample; and the large errors in determining the scattering plane arising from multiple scattering.

27927 PROTON–PROTON COLLISONS AT 5.1 Bev. Jack Gordon Parks (Univ. of Washington, Seattle). Dissertation Abstr., 22: 3236-7(Mar. 1962).

Ilford G-5 emulsions were exposed to a 5.1-Bev proton beam. Of the interactions located, 26 could be classified as elastic collisions of beam protons with free hydrogen nuclei. After correction for scanning efficiency and background events, an elastic scattering cross section of 10.0 ± 2.1 mb was obtained. The center-of-mass system angular distribution of elastically scattered protons was sharply peaked in the forward and backward direction and was in fair agreement with the prediction of a uniform optical model. Inelastic collisions were examined using multiple scattering, grain density, range, and angle measurements on secondary tracks. The results indicated a cross section of 15.8 ± 2.8 mb for two-prong events, 10.6 ± 2.2 mb for four-prong events, and 1.9 ± 0.9 mb for six-prong events, giving a total inelastic cross section of 28.3 ± 3.7 mb. The average pion multiplicity was found to be 2.7 ± 0.3. Comparison of observed partial inelastic cross sections with the predictions of the Fermi statistical theory indicated that this theory underestimated the relative probability for states with high meson multiplicity. Considerable forward and backward peaking was observed in the center-of-mass system angular distributions for secondary protons, and, to a lesser extent, for secondary charged pions. Center-of-mass system momentum distributions for secondary charged pions peaked at lower momenta than predicted by the statistical theory, while those for protons peaked somewhat higher than predicted. Effects were discussed that would account for these discrepancies.

27928 ANALYSIS OF K^--MESON ABSORPTION BY THE DEUTERON. Roy Louis Schult (Cornell Univ., Ithaca, N. Y.). Dissertation Abstr., 22: 3238(Mar. 1962).

The branching ratios for the $K^- + d \rightarrow \pi + Y + N$ reactions are experimentally quite different from the corresponding $K^- + p \rightarrow \pi + Y$ branching ratios. Part of this difference is a result of inelastic nucleon-hyperon scattering in the final state. Three approximate sum rules are derived, which show that there is a large residual discrepancy independent of nucleon-hyperon final state interactions. In an effort to understand the cause of this discrepancy, several other effects are estimated. Among these are multiple scattering of the hyperon in the final state, multiple scattering of the K^--meson in the initial state, and violations of charge independence as a result of the neutron-proton and K^--$\overline{K^0}$ mass differences. None of these effects is large enough to explain the observed branching ratios. The most likely explanation of the discrepancy is the presence of an isospin zero $\pi\Sigma$ resonance a few Mev below the $K^- + p$ threshold. Because of the deuteron binding energy and the recoil energy of the nucleon, the deuteron reactions take place in the energy region of this resonance. The difference between the proton and deuteron branching ratios arises from the large energy dependence of the reaction amplitudes introduced by the resonance. The relationship of this $\pi\Sigma$ resonance to the $\pi\Lambda$ resonance and to the $K^- + p$ scattering parameters is also discussed.

27929 NEUTRAL MESON PHOTOPRODUCTION FROM COMPLEX NUCLEI. Roald Amundsen Schrack (Univ. of Maryland, College Park). Dissertation Abstr., 22: 3239 (Mar. 1962).

The angular distribution of neutral mesons produced by 170-Mev bremsstrahlung on the complex nuclei C, Al, Cu, Cd, and Pb is measured by means of coincident detection of the decay photons in a scintillation counter system. The experimental data are analyzed by means of a Monte Carlo code synthesis of predictions based on an impulse-approximation elastic coherent production model. The predictions are compared to experimental data, and the measure of fit (χ^2 test) is used as an indication of the merit of the density distribution of nucleons used in the generation of the predictions. With the assumption that the predictions for the nuclei measured should have the same normalization, a straight line fit can be made to the results for the rms radius of the distribution of nucleon centers of $\langle r^2 \rangle^{1/2} = 0.4 + 0.8\ A^{1/3}$. The spin-independent part of the neutral meson photoproduction cross section from hydrogen used in the coherent production model pre-

dictions for the complex nuclei is obtained using dispersion theory. The hydrogen cross section so derived is highly dependent on the values of the meson–nucleon phase shifts used. The dependence of the normalization ratio of prediction to experimental data is investigated. A set of phase shifts is presented that results in a unity normalization ratio.

27930 PION INTERACTIONS AT 1.3 Bev. William Danks Shephard (Univ. of Wisconsin, Madison). Dissertation Abstr., 22: 3239(Mar. 1962).

A study was made of the interactions of 1.3-Bev π^- mesons in a 12-in. propane bubble chamber. Out of 1401 two-prong interactions measured and analyzed, 587 were classified as hydrogen interactions. Other types of π^-–p interactions were also analyzed. Techniques used in scanning, measurement, and analysis, and the errors involved in these techniques, were discussed with special reference to the problem of carbon contamination. Corrections were calculated. Cross sections for the different possible π^-–p interactions were listed. Results of the study of elastic scatterings and multiple pion productions were presented. The data on single pion production processes were compared in detail with the predictions of the statistical model, the isobar model, and the pion–pion interaction theory. The extended isobar model gave qualitative agreement with some features of the c. m. momentum distributions, but quantitative agreement was poor. Evidence was found for a resonance in $\sigma_{\pi\pi}(\omega)$ near 750 Mev total energy for the dipion system. The data were consistent with a resonance in the T = J = 1 π-π state. A rise in the π-π cross section at low energies was also found. Differences in the results for (π^-,π^+,n) and (π^-,π^0,p) production events are considered. Evidence for final state pion-nucleon interactions in conjunction with pion–pion interactions was presented. It appeared possible to explain many features of the data from this experiment in terms of this combination.

27931 PROTON-NEUTRON SCATTERING AT 5.1 Bev. Chen-Hsiang Tsao (Univ. of Washington, Seattle). Dissertation Abstr., 22: 3240(Mar. 1962).

A monochromatic proton beam of 5.1 Bev was used for studying the scattering of the protons by bound neutrons in nuclear emulsion. A total of about 500 nucleonic events was found by on-track scanning as well as by following the light charged secondaries. Of these about 200 were identified as inelastic p-n events. The inelastic cross section for p-n scattering was determined to be between 31.3 to 36.5 mb compared to 25.5 mb for inelastic p-p scattering. Directional asymmetry was found among the charged particles emitted in the forward and backward directions in the cms. No charge exchange scattering was observed, indicating a cross section less than 1.4 mb in comparison with the elastic cross section of 8.7 mb in p-p scattering at the corresponding energy. A modified directional isobar model was proposed for possible explanation of the main characteristics of the proton-neutron scattering. The model also provided means to calculate the cross sections for p-n and p-p scattering at this energy in terms of the pion-proton scattering cross sections at 760 Mev. The result was also compared with that calculated from the statistical model, which took into consideration the formation of the isobaric states T = $\frac{3}{2}$ and T = $\frac{1}{2}$. Diffraction scattering of the incident protons with emulsion nuclei was discussed.

27932 MESON AND HYPERON MASS DIFFERENCE. N. Straumann (Universität, Zurich). Helv. Phys. Acta, 35: 113-36(1962). (In German)

The mass differences of the various meson and hyperon charge multiplets are calculated (π and K mesons, Σ and Ξ hyperons). It is assumed that the theoretical masses of a charge multiplet are equal and that the experimental mass differences rest on self energy effects. The self energies are calculated on the basis of field theory to the order e^2 and e^2f^2 (f = coupling constant of the strong interactions). The method is similar to the calculation of the nucleon mass difference by O'Raifeartaigh, Terreaux and Sredniawa). The Prentki-d'Espagnat coupling is used. For π mesons the purely electromagnetic self energy is dominant. For K mesons this is smaller by a factor 3. The e^2f^2 effect is about equal for both particles and has the opposite sign of the e^2 effect. Quantitatively, for a cut-off K_0 = nucleon mass, it is still too small by a factor 3 to 5 to overcompensate the purely electromagnetic self energy but it increases $\sim K_0^2$ (compared with $\sim K_0^2$ for the e^2 effect). The correct mass difference could be obtained for $K_0 \sim 1.6\ m_N$, which, however, is inconsistent with the quasi-static approximations used. For the Σ's the π interactions give no splitting of Σ^+ and Σ^- as a group theoretical argument shows. The K interactions yield a contribution much too small. For the Ξ's the π interactions give the same result as for nucleons if one assumes global symmetry. The K interactions contribute very little. The connection with other attempts based on dispersion relations and the experimental form factors of the nucleons is discussed. (auth)

27933 DETERMINATION OF THE VALUE OF THE GYROMAGNETIC RATIO OF PROTONS. G. K. Yagola, V. I. Zingerman, and V. N. Sepetyĭ. Izmeritel'naya Tekh., No. 5: 24-9(1962). (In Russian)

Determination of the exact value of the gyromagnetic ratio of protons is of great importance for increasing the accuracy of atomic reference standards used in electrical and magnetic measurements and for calculating the magnetic induction. The measurements were carried out by determining the frequency of the Larmor precession of the protons in samples suspended in a magnetic field and measuring the induction. Fields with magnetic induction ranging from 0.2 to 0.5 weber/m^2 were used for the experiments together with high-frequency generators with nominal values of 10 and 20 microhertz; the frequency stabilized with thermostated quartz did not vary by more than $5 \cdot 10^{-7}$ during the measurements. A 0.1 M aqueous solution of $NiSO_4^7H_2O$ was used for the determination of the gyromagnetic ratio. The average value of the measurements was $\gamma = 2.67505 \cdot 10^8 \pm 0.00005 \cdot 10^8$ $(weber/m^2)^{-1}$ sec. (TTT)

27934 DETERMINATION OF THE GYROMAGNETIC RATIO OF GAMMA PROTONS USING THE FREE NUCLEAR INDUCTION METHOD. B. M. Yanovskiĭ and N. V. Studentsov. Izmeritel'naya Tekh, No. 6: 28-31 (1962). (In Russian)

Data obtained by the authors on the gyromagnetic ratio were published previously (Izmeritel'naya Tekhnika (1959) No. 2; Trudy Komiteta Standardov, Mer i Izmeritel'nykh Priborov, 114: 54(1961)). This work was further continued for obtaining more reliable results. The experimental setup of the free nuclear induction method, used for the measurements included a sensing element with a detecting coil which contained a 2.8-cm^3 ampoule with distilled water, surrounded by a magnetizing coil; Helmholtz coils, an amplifier and a frequency meter. The average value of the measurements, $\gamma = (267506 \pm 6) \cdot 10^3$ $weber^{-1} \cdot m^2 \cdot sec^{-1}$, agrees well with that obtained by G. K. Yagola et al (Izmeritel'naya Tekhnika 24-9 (1962) No. 5.) (TTT)

27935 PAIRED ANGULAR CORRELATION OF SECONDARY PARTICLES FORMED BY THE INTERACTION

OF 9-Bev PROTONS WITH THE NUCLEI OF THE EMULSION. A. P. Mishakova and B. A. Nikol'skii (Kurchatov Inst. of Atomic Energy, Academy of Sciences, USSR). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 585-91(Apr. 1962). (In Russian)

A simultaneous determination of the angular distribution and the energy spectra is very desirable for obtaining a complete picture on the interaction of secondary particles but in view of the difficulties encountered in the determination of the energy of fast particles in the emulsion the problem was solved by measuring the relative angles between the tracks of secondary particles formed by the interaction of 9-Bev protons with nuclei of the photoemulsion. This was expected to reveal the existence of a systematic correlation between the direction of flight of the secondary particles as a result of π-π interactions and to indicate the presence of short-lived particles which decay into charged particles with half lives of 10^{-15} to 10^{-16} sec, showing also azimuthal anisotropy in the distribution of the charged particles. A 10 × 10 × 5-cm emulsion chamber was exposed to the internal 9-Bev proton beam of the cyclotron of the Joint Institute of Nuclear Research. Examination of 375 interactions indicated that the azimuthal anisotropy of the secondary particles, defined as the coefficient $\underline{a}$ in the equation $F(\phi) = \frac{1}{2}\pi\,(1 + \underline{a}\cos 2\phi)$, is equal to 0.135 ± 0.150. In the above expression $F(\phi)$ refers to the azimuthal distribution of the angles ϕ. (TTT)

27936 EMISSION OF DOUBLY-CHARGED HIGH-ENERGY PARTICLES IN NUCLEAR DISINTEGRATIONS DUE TO PROTONS. Zh. S. Takibaev, V. A. Kobzev, G. R. Tsetskova, and E. V. Shalagina. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 592-5(Apr. 1962). (In Russian)

In the star-type nuclear disintegrations caused by cosmic-ray particles occasionally fragments with such high energies are expelled that they cannot be explained by nuclear evaporation or fission. For this reason, doubly-charged high-energy particles were studied in the stars formed by 9-Bev protons in a container of photoemulsion by following all the tracks originating in interactions with an ionization of $G \geq 4G$ and forming an angle of $\phi \leq 10°$ with the plane of the emulsion. The tracks of the doubly-charged particles were separated from the tracks due to protons, deuterons, and tritons. The dependence of the grain density and of the kinetic energy on the path length and that of the grain density on the kinetic energy were used to identify the particles; measurement of the track width served to identify the tracks of the α particles. The distribution of the He isotopes, deuterons, and tritons, and protons was obtained from the value of the average sagittas. The most energetic particle participating in a secondary interaction had a kinetic energy of E_k = (1969 ± 512) Mev with a range of L = 3000μ in the photoemulsion without changing its ionization. One track was identified as being caused by a proton with a kinetic energy of (370 ± 52) Mev, another one was due to an ~800-Mev proton. A detailed analysis of the 14 tracks showed that they were caused by doubly-charged particles with energies ranging from 100 to 2000 Mev. (TTT)

27937 ELECTROMAGNETIC PROCESSES ACCOMPANYING THE MULTIPLE GENERATION OF PARTICLES. I. L. Feinberg (Lebedev Inst. of Physics, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 622-34(Apr. 1962). (In Russian)

In case of multiple generation at very high energies, mostly π-mesons are obtained. It is assumed that the generated nucleon-antinucleon and other pairs annihilate each other completely, transferring their energies to π-mesons. However, difficulties due to the field theory prevented the development of a quantum thermodynamic theory of the interacting fields. Closer examination of this problem indicated that a study of the electromagnetic processes accompanying the multiple generation may suggest experiments which may clarify the nature of strong interactions. The generation of μ-mesons and of electrons appear to be especially suitable for such study because the mechanism of the generation of these particles is not yet established. It may be assumed that there are 2 threshold energy ranges and the energy is evenly distributed between the π-meson and photon levels of freedom and among the previous ones and the μ-meson and electromagnetic levels of freedom. This however, may be true only at impossibly high energies. The problem is connected with the equations of state of the meson-nucleon plasma. (TTT)

27938 NONLINEAR SCALAR FIELDS AND THE MULTIPLE GENERATION OF PARTICLES. G. A. Nilekhin (Lebedev Inst. of Physics, Moscow). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 635-41(Apr. 1962). (In Russian)

Heisenberg repeatedly emphasized the importance of the nonlinear member of the field equation in his field theory on the multiple generation of particles. His approach was applied to certain types of scalar, nonlinear fields, basing the study on the assumption that in view of the large number of particles participating in the process, the effects of the noncommutability of the field operators play only a secondary role; thus, the field may be considered as a classical one. The solution derived was based on the similarity between the field equations and the hydrodynamic equations. The results indicated that the multiplicity of secondary particles and their angular distributions depend basically on the degree of the derivative of the interaction; from this one may conveniently apply Heisenberg's results to the Born-Infeld Lagrangian function. The angular distribution of secondary particles was found to depend only weakly, logarithmically, on the primary energy; the multiple character depends most strongly on energy. At the energy levels reached at present (10^{12} to 10^{14} ev), the higher derivatives not play yet a strong role but they may at higher energy levels. (TTT)

27939 THE PROBLEM OF γ-QUANTA AND μ-MESON EMISSION IN THE MULTIPLE GENERATION PROCESS AT HIGH ENERGIES. Yu. S. Vernov and I. N. Sisakyan. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 642-50(Apr. 1962). (In Russian)

During multiple generation at high energies, the collision of particles on the basis of the fluctuations of electric charges in the pion-nucleon plasma should result in the emission of γ-quanta, μ-mesons, and electron pairs. This radiation may be determined from measurements of the radiation intensity of each element of the plasma and by the integrated radiation during the decomposition of the plasma cluster until it decays into its component particles. The probable level of this effect was estimated on the basis of a rough model. The quantum field theory cannot yield a satisfactory answer because of the difficulties inherent in the theory of strong interactions; for this reason the radiation intensity of a volume element was estimated by making use of the pertubation theory, considering the plasma as a pion and nucleon gas at the given temperature. In the calculation of the integrated radiation it was assumed that the decomposition may be defined by the Landau-type hydrodynamics. (TTT)

27940 BASIC CHARACTERISTICS OF THE COLLISION OF HIGH-ENERGY NUCLEONS. G. T. Zatsepin. Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 26: 674-81(Apr. 1962). (In Russian)

According to present concepts of nucleon-nucleon collisions, the nucleons may pass into an isobaric state with a subsequent emission of a meson. Under experimental conditions, a meson emitted by a high-energy nucleon possesses about 15 to 20% of the energy of the original nucleon. As a result of the rapidly decreasing spectrum of the primary cosmic rays, the contribution of fast π-mesons in a flux of π-mesons of a given energy to the total energy is higher than that of the more numerous slow mesons. It was established that the coefficient of inelasticity is independent from the energy of the colliding nucleons within the wide range of 3×10^{10} to 10^{14} ev. The collision process of high-energy nucleons may be divided in 2 stages: a first stage, corresponding to the collision proper, which has a quantic character and is accompanied by the formation of an excited meson cloud and nucleon; and a second stage involving expansion and decay of the system, resulting in the generation of slow π-mesons. High-energy nucleons with $E_0 > 3 \times 10^{10}$ ev usually enter into purely peripheral collisions. Excited meson clusters decay isotropically, generating low energy, 0.5-Bev π-mesons. The π-mesons interact strongly with each other, forming excited meson masses, although the probability of forming masses higher than 2 to 4×10^9 ev/c decreases with increasing energy. (TTT)

27941 INTRINSIC ENERGY, SPIN AND RADIUS OF A FREE ELECTRON. L. E. Lebedev (Dnepropetronvskii State Univ., USSR). Izvest, Vysshikh Ucheb. Zavedenii, Fiz., No. 3, 38-40(1962). (In Russian)

An analysis was made of the singular resolution concept of the spinor equation in integral form. An evaluation is made of a series of new physical characteristics of free electrons. (R.V.J.)

27942 ON THE RELATION OF TRANSMISSION-LINE THEORY TO SCATTERING AND TRANSFER. Raymond Redheffer (Univ. of California, Los Angeles). J. Math. Phys., 41: 1-41(Mar. 1962).

A general equation for scattering processes; applicable to neutron transfer, circuit theory, and probability, is developed. Equations for these specialized disciplines are shown to be special cases of this generalized equation. (L.N.N.)

27943 ELECTRON SPIN ROTATION AND BEAM FOCUSING. P. S. Farago (Univ. of Edinburgh, Eng.). Nuclear Instr. & Methods, 15: 222-30(Apr. 1962). (In English)

It is shown that it is possible to produce superimposed electric and magnetic fields having a common axis of cylindrical symmetry and a common plane of mirror symmetry, which act in the following way. Electron beam focusing takes place both in the plane of mirror symmetry and in the direction perpendicular to it, in first order approximation image formation is stigmatic. The positions of cardinal points are independent of electron energy and, if the beam is polarized, the rotation of the direction of polarization between source and image is also independent of electron energy. The fields defined by the components $E_z = E_0(R/r)^2$, $E_\vartheta = E_r = 0$, $B_r = B_\vartheta = 0$, $B_z = B_0(R/r)$ $R = \text{const}$) in the $z = 0$ plane of a cylindrical coordinate system represent a simple example. (auth)

27944 THE INFLUENCE OF π-π RESONANCE UPON WEAK INTERACTIONS. L. Łukaszuk (Univ. of Warsaw). Nuclear Phys., 33: 693-5(June 1962). (In English)

It is shown that the electromagnetic and weak nucleon form factors have a similar structure, if the domination of the π-π resonance is justified. (auth)

27945 ELASTIC D-D-SCATTERING IN THE IMPULSE APPROXIMATION. EXPRESSIONS FOR THE M-MATRIX. Olle Brander (Chalmers Univ. of Tech., Göteborg). Nuclear Phys., 36: 82-108(July 1962). (In English)

By means of the impulse approximation the M-matrix for elastic scattering of deuterons by deuterons is expressed in the Wolfenstein and Ashkin invariants for p-p (n-n) and n-p scattering, assuming general two-body, parity conserving nuclear forces and neglecting Coulomb forces. Off-the-energy-shell and multiple scattering contributions are omitted. The deuteron D-state is considered to first order. Finally, the general form of the M-matrix is derived, and the invariant functions of this form are expressed in the nucleon-nucleon invariants. (auth)

27946 AN UNSUBSTRACTED DISPERSION RELATION AND PION-NUCLEON FORWARD CHARGE-EXCHANGE SCATTERING. T. D. Spearman (CERN, Geneva). Nuclear Phys., 36: 386-93(Aug. 1962). (In English)

An unsubtracted dispersion relation which relates the real part of the pion-nucleon charge-exchange forward amplitude to the total cross sections for π^+-p scattering is written down. The validity of this equation is discussed and its relation to the once subtracted dispersion relation. It is used to calculate the real part of the forward charge-exchange amplitude; the results are presented and their comparison with experiment discussed. (auth)

27947 ON Λ^0 HYPERONS PRODUCED IN K^- INTERACTIONS WITH EMULSION NUCLEI. A. Filipkowski, E. Marquit, E. Skrzypczak, and A. Wróblewski (Univ. of Warsaw). Nuovo cimento (10), 25: 1-14(July 1, 1962). (In English)

The energy spectrum of Λ^0 particles produced by K^- interactions at rest in emulsion and found by following back-stopping π^- mesons to the point of Λ^0 decay was determined. The experimentally found spectrum is corrected for systematic losses. The frequency of Λ^0 emission in K^- interactions and the frequency of production of cryptofragments are estimated. An analysis of other experimental results indicates that scanning biases are present in samples of Λ^0 decays found in emulsion by the area-scanning technique. These biases, differing from experiment to experiment, can lead to an apparent forward-backward asymmetry in the Λ^0 decay and to an underestimation of the number of Λ^0 particles emitted. (auth)

27948 PARTIAL WAVE DISPERSION RELATIONS FOR PHOTON-NUCLEON SCATTERING AND NUCLEON-ANTINUCLEON PRODUCTION BY PHOTONS. A. P. Contogouris (Cornell Univ., Ithaca, N. Y.). Nuovo cimento (10), 25: 104-34(July 1, 1962). (In English)

Partial-wave dispersion relations for the processes $\gamma + N \to \gamma + N$ and $\gamma + \gamma \to N + \bar{N}$ to the order e^2 are derived using the Mandelstam representation. The angular momentum decomposition for both processes is carried out, and the analytic properties of the partial wave amplitudes are determined. The absorptive parts of these amplitudes along part of the physical branch cuts are calculated using the unitarity condition. For $\gamma + N \to \gamma + N$, the resulting expressions involve amplitudes for single-pion photoproduction: for $\gamma + \gamma \to N + \bar{N}$, they involve the $T = 0$ s-wave pion-pion phase shift and the total cross-section for the process $\gamma + \pi \to \pi + \pi$. The discontinuities along the unphysical branch cuts are calculated using crossing symmetry and of analytic continuation through Legendre polynomials. The limits of convergence of the Legendre expansions are discussed, and reasons for the importance of the two-pion exchange contribution in photon-nucleon scattering are presented. (auth)

27949 EFFECTS OF THE Y^* ON THE $\bar{K}$-N LOW ENERGY S-WAVE PARAMETERS. E. Pagiola (Università,

Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 25: 169-74(July 1, 1962). (In English)

An analysis of the energy of the $\overline{K}N$ S-wave scattering lengths near the threshold is performed using the following hypotheses: the Y* can be regarded as an unstable particle having complex mass, which is coupled to the states having the same quantum numbers, dominating the nearby energy regions. The spin of the Y* is assumed to be ½. Only the I = 0 isospin state is discussed. (auth)

27950 COUPLING CONSTANTS AND S-MATRIX ZEROS. C. H. Albright and W. D. McGlinn (Northwestern Univ., Evanston, Ill.). Nuovo cimento (10), 25: 193-205 (July 1, 1962). (In English)

A connection between coupling constants and S-matrix zeros exists in the case of elastic scattering of neutral, scalar particles. From analyticity and unitarity arguments, the most general solution for a partial-wave phase shift is written in terms of the given discontinuities across the dynamical and inelastic branch cuts. The coupling constants associated with the simple poles follow directly from these phase shift solutions. Under certain conditions, the arbitrariness in the solutions can be exhibited entirely by the position and number of S-matrix zeros. A simple dynamical assumption is introduced as an illustrative example of a possible physical restriction on these zeros, and two coupling constants are calculated using rough approximations. (auth)

27951 SOME REMARKS ON ULTRARELATIVISTIC PION-NUCLEON INTERACTIONS. Uri Maor (Weizmann Inst. of Science, Rehovoth, Israel). Nuovo cimento (10), 25: 206-10(July 1, 1962). (In English)

Data concerning secondary jets were re-examined to compare π-N and N-N interactions at high energies. Strong anisotropic angular distributions of π-N events show a significant deviation from the distribution predicted by a hydrodynamical theory. The close multiplicities and inelasticity factors for π-N and N-N collisions in the same energy region suggest that both types of interactions should be described phenomenologically by a two-step process in which two slow "fire balls" are created in the center-of-mass system, related to the two energetic bare parent particles. A similar mechanism describing π-N and N-N interactions is also predicted by the "super-peripheral" model of high-energy strong interactions. (L.N.N.)

27952 ELASTIC SCATTERING OF Σ^+-HYPERONS ON PROTON. B. Bhowmik, P. C. Jain, and P. C. Mathur (Univ. of Delhi). Nuovo cimento (10), 25: 211-13(July 1, 1962). (In English)

A Σ^+, produced by capture of a K^- in an emulsion nucleus, was elastically scattered by a proton, it then decayed in the mode $\Sigma^+ \rightarrow p + \pi^0$. Energies, cross sections, and angular distributions were measured; a potential of the GT or Bryon type is suggested. (L.N.N.)

27953 HEAVY MESONS AND THE CHARGE INDEPENDENCE OF THE NUCLEAR FORCES. Y. Nogami and I. P. Varshni (National Research Council, Ottawa). Nuovo cimento (10), 25: 218-21(July 1, 1962). (In English)

The mass spectrum of the ρ^0 appears to be resolved into two levels, one of which is almost degenerate to the ω within experimental errors. Possibilities of finding differences between the theory of S. Fubini (Phys. Rev. Lett., 7: 466 (1961)) and that of S. L. Glashow (Phys. Rev. Lett., 7: 469 (1961)) in their effects on nuclear forces are examined. Possibilities of detecting the effects of the Γ meson effects on the nuclear are discussed. Indications are unfavorable to the existence of the Γ. (L.N.N.)

27954 A NOTE ON GAUGE THEORIES OF VECTOR PARTICLES. S. T. Epstein (Univ. of Nebraska, Lincoln). Nuovo cimento (10), 25: 222-3(July 1, 1962). (In English)

Almost any theory can be made generally covariant without changing its physical content. Ordinary derivatives are replaced by covariant derivatives, and the requirement that the Riemann-Christoffel tensor vanish is appended as "field equations." Similarly, any theory that is invariant to constant-phase gauge transformations can be made invariant to extended gauge transformations. Invariance alone does not require the introduction of dynamically-coupled gauge fields. (L.N.N.)

27955 LAGRANGIAN THEORY OF COMPOSITE PARTICLES. A. Salam (Imperial Coll. of Science and Tech., London). Nuovo cimento (10), 25: 224-7(July 1, 1962). (In English)

Distinctions between elementary and composite particles within the context of the Feynman-Dyson type of S-matrix theory are considered. Requirements that the bare coupling constant for the interaction of a composite particle and its elementary constituents should vanish and that there should be no mass renormalization for a composite particle are exploited. Results corroborate Feynman's principle of impotence in distinguishing between elementary and composite particles. (L.N.N.)

27956 REMARKS ON PARITY CONSERVATION AND PARTICLE-ANTIPARTICLE CONJUGATION INVARIANCE IN STRONG INTERACTIONS. I. Saavedra (Imperial Coll. of Science and Tech., London). Nuovo cimento (10), 25: 229-36(July 16, 1962). (In English)

A simple theorem, giving a sufficient condition for CP invariance to imply P invariance in a Lagrangian containing only non-derivative Yukawa-type couplings, is proved. From this theorem several results concerning the system of strongly interacting particles are obtained. The physical bases of these results, namely charge independence and the hermiticity of the Hamiltonian, are evident in this discussion. The construction of a parity-conserving strong Lagrangian is examined, and the role of particle-antiparticle conjugation in providing reality conditions for the coupling constants of the strong Lagrangian is discussed. (auth)

27957 ON THE CONTINUATION OF PARTIAL-WAVE AMPLITUDES TO COMPLEX l. E. J. Squires (Univ. of California, Berkeley). Nuovo cimento (10), 25: 242-53 (July 16, 1962). (UCRL-10033). (In English)

A formal definition of a continuation of partial-wave amplitudes from physical l values is given, and shown to be unique. The cases of potential scattering and of a relativistic S-matrix theory satisfying the Mandelstam representation are then considered in detail. (auth)

27958 MESON-BARYON SCATTERING IN HIGHER SYMMETRY SCHEMES. P. G. O. Freund, H. Ruegg, and D. Speiser (Université, Geneva). Nuovo cimento (10), 25: 307-19(July 16, 1962). (In English)

Relations between meson-baryon scattering cross sections are derived for the octet version of unitary symmetry and for the G_2 symmetry. It is shown that in all higher symmetry schemes for high energies the relation $\sigma_{tot\pi^-p} = \sigma_{totK^-p} = \sigma_{tot\pi^+p} = \sigma_{totK^+p}$ is valid. (auth)

27959 STRONG INTERACTION SYMMETRIES AND RELATIONS BETWEEN POLARIZATIONS FOR $\bar{p}p \rightarrow \bar{Y}Y$. E. de Rafael (Physique Theorique et Hautes Energies, Orsay, France). Nuovo cimento (10), 25: 320-36(July 16, 1962). (In English)

The consequences of different symmetry groups for strong interactions are studied in terms of relations be-

tween polarizations. Some experimental tests concerning antihyperon-hyperon production by means of $\bar{p}p$ and $\bar{p}d$ annihilations are proposed. (auth)

27960 THE 27-FOLD WAY AND OTHER WAYS: SYMMETRIES OF MESONS-BARYON RESONANCES. S. L. Glashow (Stanford Univ., Calif.) and J. J. Sakurai. Nuovo cimento (10), 25: 337-54(July 16, 1962). (In English)

Meson-baryon resonances are discussed within the framework of unitary symmetry based upon the Gell-Mann–Ne'eman baryon octet (the eightfold way). It is argued that the low-lying $J = {}^3/_2{}^+$ isobars ($N^*_{3/2}$, Y^*_0, Y^*_1, Y^*_2, etc) realize a twenty-seven-dimensional representation of SU(3). Purely group-theoretic considerations directly following from unitary symmetry are compared with dynamical considerations suggested by the coupling constant combinations required by unitary symmetry and R-symmetry. Higher resonances are discussed. (auth)

27961 INVESTIGATION OF RESONANT π-π INTERACTION IN THE J = 1, T = 1, STATE. J. Alitti, J. P. Baton, A. Berthelot, et al. (Laboratoire de Physique Corpusculaire à Haute Energie, Saclay). Nuovo cimento (10), 25: 365-73(July 16, 1962). (In English)

The reaction $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ in the region of small momentum transfer to the proton is studied with 1.59-Bev/c pions in a hydrogen bubble chamber. Using the Chew-Low formula as valid in the physical region the elastic π^--π^0 cross section is calculated. It shows a well-defined peak at 29 μ^2, the total energy squared in the center of mass of the dipion. On the basis of the angular distribution of the π-π scattering it is demonstrated that the peak is caused by a resonant interaction in the state J = 1, and therefore T = 1. (auth)

27962 WEAK ELECTROMAGNETIC AND PIONIC DECAY OF HYPERONS. J. Nuyts (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo cimento (10), 25: 374-84(July 16, 1962). (In English)

Using the pole approximation for the weak-electromagnetic and pion decays of hyperons, the relative number of experimental (measured and to be measured) and theoretical parameters are discussed. This gives the minimum conditions for testing the theory. (auth)

27963 THE PION-PION INTERACTION IN THE K_{e4} DECAY. G. Ciocchetti (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo cimento (10), 25: 385-91(July 16, 1962). (In English)

The K_{e4} decay mode has a certain importance in the study of the pion-pion interaction. For this reason it is useful to study the K_{e4} decay taking into account this π-π interaction. The momentum distribution of the pions in their center-of-mass system is calculated for three values of the $\pi\pi$ coupling constant, along with the decay rate enhancement factor. The shape of the momentum distribution is found to be sensitive to the $\pi\pi$ final state interaction, but the decay rate turns out to be very little increased. The results are compared to those obtained using the Fermi method. (auth)

27964 ON POSSIBLE SIMPLE FORMS OF THE COLLISION MATRIX FOR STRONGLY INTERACTING PARTICLES AT VERY-HIGH ENERGIES. L. Van Hove (CERN, Geneva). Nuovo cimento (10), 25: 392-403(July 16, 1962). (In English)

In multi-Bev collisions of strongly interacting particles, readily measurable quantities like total and elastic cross sections, multiplicity, and momentum distribution of secondaries are found to have a very simple energy-dependence suggestive of an asymptotic region. It seems natural to expect the whole S-matrix to become simple in this region. As an exploration of what this expectation might imply, some possible simple forms of the S-matrix compatible with the existence of inelasticity, the purely imaginary character of the elastic scattering amplitude, and the requirements of unitarity and invariance are discussed. The first criterion of simplicity chosen for study is the condition that S have as few eigenvalues $\neq 1$ as possible, i.e., that the number of nonvanishing eigenphases be minimum. This minimum number turns out to be two for each angular momentum and, if it is realized, the operator S is completely determined by the knowledge of how it acts on the initial state. The second criterion considered is a reality condition more comprehensive than the observed imaginary character of the elastic-scattering amplitude. Together with the first it means that the two nonvanishing eigenphases of S for given angular momentum become opposite of each other, a property which has some relation to speculations on what may be regarded as the number of "elementary" particles. The two criteria considered are presented solely as theoretical possibilities; it is not known whether they are fulfilled by the actual S-matrix of strongly interacting particles. (auth)

27965 PION AND STRANGE PARTICLE PRODUCTION BY 1 Gev NEUTRINOS. J. S. Bell and S. M. Berman (CERN, Geneva). Nuovo cimento (10), 25: 404-15(July 16, 1962). (In English)

Estimates are made of cross sections for the production of pions or strange particles by high-energy neutrinos incident on nuclei. At 1 Bev the production of pions via the (33) resonance is found to augment the total cross section by about 50%. (auth)

27966 TWO-NEUTRINO HYPOTHESIS AND LEPTON-BARYON SYMMETRY. C. Iso (Brandeis Univ., Waltham, Mass.). Nuovo cimento (10), 25: 456-8(July 16, 1962). (In English)

It is assumed that there exist two types of neutrinos, which constitute a single four-component neutrino. Conservation of lepton number is also assumed. It is shown that the μ^+, e^-, and ν must have lepton number +1. The weak interaction Hamiltonian is obtained for this neutrino scheme. The weak current is found to be symmetric under the replacements: $\mu^+ \rightarrow \Lambda$, $\nu \rightarrow p$, and $e^- \rightarrow n$. The baryon current is calculated and used to study the decays $\Lambda \rightarrow$ nucleon + pion. The model predicts the $A\beta$ decay to be of the V + A type, while the neutron β decay is predicted to be V − A. (T.F.H.)

27967 HIGH-ENERGY BEHAVIOUR OF PION-PION SCATTERING AMPLITUDES. B. H. Bransden (The University, Glasgow) and J. W. Moffat. Nuovo cimento (10), 25: 459-60(July 16, 1962). (In English)

The double spectral functions $\rho_l(s,t)$ for the two-pion-exchange approximation are calculated, using s and p partial-wave amplitudes as trial functions, and utilizing an iteration procedure that yields results consistent with unitarity requirements. For the region in which only s wave effects are non-negligible, the function Im $A^1_l(s)$ decreases as $s \rightarrow -\infty$, and does not oscillate. In the region in which the physical p wave resonance must be included in the trial function Im $A^1_l(t)$, however, large and rapid oscillations are exhibited in Im $A^1_l(s)$ as $s \rightarrow -\infty$. These oscillations are produced by the $\rho_l(s,t)$ for definite values of the isotopic spin. (T.F.H.)

27968 DIFFRACTION SCATTERING OF 4.5 Gev π^- MESONS IN EMULSIONS. S. Jannelli and F. Mezzanares (Universita, Messina, Italy and Istituto Nazionale di Fisica Nucleare, Messina, Italy). Nuovo cimento (10), 25: 469-78(Aug. 1, 1962). (In English)

The scattering of 4.5-Bev π^- mesons by emulsion nuclei is studied and the experimental data are corrected for the scanning losses at the smaller angles. The cross sections of absorption (S_a) and diffraction (S_d) and the spatial angular distribution are derived on the assumption of the Fermi model. The experimental data seem to be consistent with the theoretical predictions and, in any case, as far as diffraction is concerned, they do not disagree. Analogous calculations with the constant density model of the nucleus are carried out for a suitable choice of r_0 and they do not differ greatly from those obtained on the assumption of the Fermi model. It seems, however, that the agreement with the Fermi model is better. The corrected experimental data lead to: $S_a = (2.52 \pm 0.07) \times 10^{-2}$ cm^{-1}; $S_d = (1.23 \pm 0.16) \times 10^{-2}$ cm^{-1}, $S_d/S_a = 0.49 \pm 0.06$. (auth)

27969 LEPTONIC DECAY OF Λ^0 AND Σ^- HYPERONS. B. Aubert (Ecole Polytechnique, Paris), B. Brisson, J. Hennessy, et al. Nuovo cimento (10), 25: 479-85 (Aug. 1, 1962). (In English)

A search for leptonic decays of Λ^0 and Σ^- hyperons is carried out in a 1-meter heavy-liquid bubble chamber. Eight Λ^0_β and no Λ^0_μ, Σ^-_β, or Σ^-_μ are found. The total number of Λ^0 is ~3200. After correction for detection efficiency, this gives for the branching ratio $N(\Lambda^0_\beta)/N(\Lambda^0_{tot}) = 0.29\%$. This result seems to be in disagreement with the simple extension of the V−A theory to this type of strangeness-nonconserving decay. (auth)

27970 ANTIPROTON-PROTON INTERACTION CROSS-SECTIONS AT 45, 90, 145, AND 245 Mev. B. Cork, O. I. Dahl, D. H. Miller, A. G. Tenner, and Ching Lin Wang (Univ. of California, Berkeley). Nuovo cimento (10), 25: 497-508 (Aug. 1, 1962). (UCRL-9829). (In English)

Through the use of a 15-in. hydrogen bubble chamber, antiproton-proton cross sections are measured. Interactions are studied in four energy intervals by insertion of suitable degraders in an electrostatically separated beam of 245-Mev antiprotons. Approximately 4000 antiprotons are incident in each of the energy intervals, namely (45 ± 20), (90 ± 20), (145 ± 17), and (245 ± 20) Mev. For the total cross sections at these energies, the values (281 ± 46), (195 ± 13), (163 ± 12), and (118 ± 9) mb are found respectively. The elastic scattering cross sections are (80 ± 10), (65 ± 6), (52 ± 6), and (45 ± 5) mb respectively. Calculations are in agreement with the measured differential cross sections. The total cross sections at 145 and 245 Mev agree with those measured with counters, while the elastic scattering cross sections are systematically 15% lower than those obtained in the counter measurements. (auth)

27971 ON THE ELECTROMAGNETIC FORM FACTORS OF MESONS AND BARYONS. N. Dallaporta and V. de Sanctis (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 25: 513-28(Aug. 1, 1962). (In English)

An extension of the model for the form factors of nucleons is proposed for all mesons and baryons, according to the following assumptions: 4-dimensional rotational invariance in isospace for the K interactions, and ordinary charge independence of π interactions for all baryon doublets; occurrence of the coupling between the photon and the elementary particles considered only through bipion (T = 1, J = 1) and tripion (T = 0, J = 1) intermediate states; and suggested invariance under G transformation for all bipion and tripion interactions with the elementary particles considered. With these assumptions, Clementel-Villi type formulas for the form factors are obtained, whose constants are normalized on the minimum necessary number of the experimental charge values. The static limit of the formulas may then be used to predict all other charge states for pions, K mesons and baryons, thus yielding a partial justification of the Gell-Mann relation between charge, isospin, and hypercharge. Some further consequences of the model and comparison with an "eight-fold way" model are discussed. (auth)

27972 THE DALITZ-PAIR SPECTRUM IN $\Sigma^0 \to \Lambda + e^+ + e^-$. L. E. Evans (Univ. of Wisconsin, Madison). Nuovo cimento (10), 25: 580-5(Aug. 1, 1962). (In English)

Measurement of the relative Σ-Λ parity by means of the process $\Sigma^0 \to \Lambda + e^- + e^+$ is considered. Spectra of the Dalitz pairs are given as functions of the "mass," energy partition, and opening angle of the pair. Form factors for the Σ-Λ-γ vertex are assumed constant. The validity of this approximation is confirmed. (auth)

27973 PION PRODUCTION BY HIGH-ENERGY NEUTRINOS. N. Cabibbo and G. Da Prato (Università, Rome and Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). Nuovo cimento (10), 25: 611-17 (Aug. 1, 1962). (In English)

An evaluation is presented of the cross sections for inelastic high-energy neutrino-nucleon interactions. The results suggest that elastic processes are dominant for neutrino energies up to a few Bev. (auth)

27974 BETA DECAY OF HYPERONS VIA K'-PARTICLE. A. Fujii (Laboratori Nazionali di Frascati, Italy). Nuovo cimento (10), 25: 618-23(Aug. 1, 1962). (In English)

The β decay rate of the hyperons and the leptonic decay rates of the kaon are calculated in an intermediate boson model, where the intermediary boson is the so-called K' particle (the observed 885-Mev K-π resonance). A preliminary numerical estimate of the coupling constants is also made. (auth)

27975 INTEGRAL EQUATION FOR HIGH-ENERGY PION-PION SCATTERING. L. Bertocchi (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna), S. Fubini, and M. Tonin. Nuovo cimento (10), 25: 626-54 (Aug. 1, 1962). (In English)

The structure of the high-energy scattering amplitude is studied in the framework of a model based on the choice of the most peripheral graphs. The imaginary part of the scattering amplitude is shown to satisfy an integral equation that has many analogies with the Bethe-Salpeter equation in the ladder approximation. In the high-energy limit it is possible to obtain a solution of the equation that exhibits the energy dependence explicitly. The analogy of the results with those obtained on the basis of the extension of the Regge theory to high-energy scattering is discussed. (auth)

27976 POSITRON-ELECTRON ANNIHILATION IN FLIGHT BETWEEN 2 AND 10 Gev. F. Fabiani, M. Fidecaro, G. Finocchiaro, G. Giacomelli, D. Harting, N. H. Lipman, and G. Torelli (CERN, Geneva). Nuovo cimento (10), 25: 655-69(Aug. 1, 1962). (In English)

The total cross section for positron-electron annihilation in flight is measured at incident positron laboratory energies of 1.94, 5.80, 7.71, and 9.64 Bev. The measured values are (0.520 ± 0.013), (0.198 ± 0.006), (0.154 ± 0.005), and (0.128 ± 0.007) mb respectively. The positron beam is obtained by conversion of photons emitted from an internal target of a proton synchrotron. The measured cross sections agree with the theoretical values including radiative corrections. (auth)

27977 BOUND STATES AND ELEMENTARY PARTICLES. F. E. Low (Univ. of Rome). Nuovo cimento (10), 25: 678-84(Aug. 1, 1962). (In English)

A simple theory is constructed within which it cannot be distinguished which of two particles (here called a nucleon and a Ξ hyperon) is elementary and which is a bound state of two other particles (here called a Λ and a K or $\bar{K}$ meson) or whether both are elementary. No conditions need be imposed on the masses except those required to ensure stability, and to ensure that the center of mass of the N and the Ξ be greater than the mass of the Λ. (auth)

27978 THE EFFECT OF INTERMEDIATE VECTOR BOSONS ON THE RATE FOR THE DECAY $K \rightarrow e + \nu + \gamma$. S. M. Berman, A. Ghani, and R. A. Salmeron (CERN. Geneva). Nuovo cimento (10), 25: 685-92(Aug. 1, 1962). (In English)

In a model for K decay via an intermediate vector boson, the branching ratio $B_\gamma = (K \rightarrow e + \nu + \gamma)/(K \rightarrow e + \nu)$ is computed as a function of the mass, the anomalous magnetic moment, and the electric quadrupole moment of the vector boson. It is shown that the intermediate vector boson could enhance B_γ by a factor of 10^3 over what it would be if there were only inner bremsstrahlung radiation. The energy spectra of the photon and electron and the electron-photon angular correlation are also computed. (auth)

27979 A NOTE ON THE STIMULATED DECAY OF THE Λ^0-HYPERON. J. Zakrzewski (Univ. of Warsaw) and S. J. St. Lorant. Nuovo cimento (10), 25: 693-7(Aug. 1, 1962). (In English)

A review is presented of experimental studies of the stimulated decay of Λ^0 hyperons in hyperfragments. In these studies, it is assumed that the decay is stimulated by nucleons, and that stimulation by one nucleon is the dominant channel. Inferences are drawn as to the mechanisms of the stimulation by analyzing the energy distributions and emission frequencies of protons emitted in the non-mesonic decay of the hyperfragments. It is suggested that the selection of events for these studies be based primarily on the detailed analysis of the hyperfragment production process involved. It is noted that it is possible, in principle, to specify a physically significant lower cutoff energy for the protons. (T.F.H.)

27980 ON THE BREAK OF THE BARYON MASS-SPECTRUM DEGENERACY BY VECTOR INTERACTIONS. S. Bonometto and N. Dallaporta (Universitá, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo cimento (10), 25: 698-700(Aug. 1, 1662). (In English)

A model for strongly interacting particles is considered that is based on an extension of the nucleon form factor model to include all baryons and mesons. The strongly interacting particle model is founded on the assumption that 4-dimensional rotational invariance of K meson interactions in hypercharge space is the fundamental symmetry of strong interactions. The physical mechanism underlying the model is conjectured to be that the photon can be coupled to any elementary particle current only through bipion or tripion intermediate states. It is shown that this model destroys charge and hypercharge independence and mass degeneracy of the baryons. This result is caused by the fact that in the model, vector particles (photon or tripion) can couple indifferently with either a charge (or hypercharge) singlet or the third component of a charge (or hypercharge) triplet. (T.F.H.)

27981 PARITY CONSERVATION IN HIGH-ENERGY PION PHOTOPRODUCTION. A. Forino, E. Fuschini, C. Maroni, and P. Veronesi (Universitá, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 25: 704-6(Aug. 1, 1962). (In English)

Angular distributions from 1.05-Bev bremsstrahlung reactions on nucleons in polyethylene (CH_2) are measured by two scintillation-counter telescopes, mounted in the plane perpendicular to the photon beam and at an angle of 90° with respect to one another. The counters are set up so that only events in which π^+-π^- pairs are emitted 90° apart are registered. Measurements are made both with the counters in a given position, and reflected through the axis formed by the photon beam. The counting asymmetry in the two positions is 0.02 ± 0.02. An upper limit is set for the relative strength (F) of the parity non-conserving coupling, viz., $F^2 \leq 4 \times 10^{-3}$. (T.F.H.)

27982 STABILITY OF THIN ELECTRON LAYERS. V. Kelvin Neil (Univ. of California, Livermore). Phys. Fluids, [5:] 14-21(Jan. 1962). (UCRL-6463)

An instability that consists of a bunching transverse to the directed motion of an infinitely thin layer of electrons is investigated theoretically. The initial model is a plane sheet, infinite in extent, and neutralized by positive ions. This configuration is found to be unstable if all electrons travel with the same relativistic velocity. If the electrons are monoenergetic, but have a small angular spread in velocities, a criterion for stability is obtained that places a lower limit on the spread. This limit is directly proportional to the wavelength of the perturbation. The theory is also applied to a thin cylindrical sheet inside a perfectly conducting cylinder. The system is infinite in the axial direction, and the electrons move in the azimuthal direction. In the absence of axial velocity, the instability is present as in the plane sheet. Considering a spread in axial velocity leads to a stability criterion independent of perturbation wavelength. A numerical example, employing the proposed parameters of the Astron device, indicates that an angular spread of about 60° is necessary for stability. (auth)

27983 EXPERIMENT AND THE ρ-MESON. J. Naisse (Universite, Libre, Brussels). Phys. Letters, 1: 247-9 (July 1, 1962). (In English)

Conclusions that can be drawn concerning properties of π-π interactions are re-examined from data on the reactions $\pi^+(\vec{k}) + p(\vec{p}) \rightarrow p(\vec{p}') + \pi^+(q_1) + \pi^0(q_2)$, where $\vec{k}$ denotes the 4-momentum vector of the incident π, etc.; $\vec{k}^2 = k^2 - K_0^2 = -\mu^2$, $\vec{p}^2 = p^2 - p_0^2 = -m^2$, ..., where $\mu = 140$ Mev and $m = 938$ Mev. The interpretation of the bump called "ρ-meson" as an $I = 1$, $J = 1$ resonance of the π^+-π^0 is not clearly established. (L.N.N.)

27984 DECAY MODES OF K^+-MESONS. M. I. Ali, Rashida Rahman, M. Masud, and A. Hossain (Dacca University, East Pakistan). Phys. Letters, 1: 250(July 1, 1962). (In English)

Meson (K^+) decay modes were observed using Ilford G-5 nuclear emulsion plates. Relative importance of each mode was measured; data are presented in tabular form. (L.N.N.)

27985 SMALL PROBABILITY OF THE $\mu \rightarrow e + \gamma$ AND $\mu \rightarrow e + e + e$ PROCESSES AND NEUTRAL CURRENTS IN WEAK INTERACTIONS. B. Pontecorvo (Joint Inst. for Nuclear Research, Lab. of Theoretical Physics, Dubna). Phys. Letters, 1: 287-8(July 1, 1962). (In English)

An extremely small probability of the U processes may be explained, even if there is only one type of neutrino in nature, assuming that there are neutral currents, as well as charge currents (R. P. Feynman and M. Gell-Mann, Phys. Rev., 109: 193(1958); R. C. G. Suderhan and R. E. Marshak, Proc. of the Padua-Venice Conf. of Elementary Particles, (1957)), in weak interactions. (L.N.N.)

27986 LOW-ENERGY RADIATION IN COLLISION PROCESSES AT VERY HIGH ENERGIES. K. E. Eriksson (Univ. of Uppsala). Phys. Letters, 1: 291-2(July 1, 1962). (In English)

Assuming a pseudoscalar or scalar coupling between baryons and mesons, the relation between the cross section σ for a high-energy ($E \gg m_N$ = nucleon mass) process and the relative experimental energy resolution $\Delta E/E$ is determined. (auth)

27987 EVIDENCE FOR RESONANCES IN K + Y(Σ,Λ) SYSTEM AT 1650 and 1920 Mev. Ye. V. Kuznetsov, Ya. Ya. Shalamov, and A. F. Grashin (Inst. of Theoretical and Experimental Physics, Academy of Sciences, Moscow) and Ye. P. Kuznetsov. Phys. Letters, 1: 314-15(July 15, 1962). (In English)

The $\Lambda^0 + K^0$ pairs produced by mesons (π^-) at 2.8 Bev/c were investigated in freon and xenon bubble chambers. The reactions $\pi^- + (A) \rightarrow \Lambda^0 + K^0 + m\pi + (A)^2$ (m = 0, 1, 2, ...) was studied. The assumption that a portion of the Λ^0 and K^0 are produced in the intermediate reactions $\pi^- + N \rightarrow Z^0 + m\pi$ (m = 1, 2, ...), where Z^0 is a particle decaying according to the scheme $Z^0 \rightarrow \Lambda^0 + K^0 + Q$ was tested by constructing the Q distribution of the $\Lambda^0 + K^0$ pair production events. Distributions are presented in graphical form. The Q value to 300 Mev had a mean error of about 20 Mev; for the xenon chamber, the mean error was about 50 Mev because of multiple-scattering-increase effects on angle determination. (L.N.N.)

27988 THE OBSERVATION OF VERY HEAVY HYPERFRAGMENTS PRODUCED BY 830 Mev/c K^- MESONS. N. A. Nickols, S. B. Curtis (Lockheed-California Co., Burbank), and D. J. Prowse. Phys. Letters, 1: 327-9 (July 15, 1962). (In English)

Heavy hyperfragments ($A \gtrsim 40$) were observed in interactions of 830-Mev/c K^- mesons with nucleons within emulsion nuclei. Two stacks were exposed to a separated K^- beam at the bevatron. Hyperfragments exhibited marked differences from those observed from K^- capture. Significant increases in numbers of non-mesonic decays and short-range hyperfragments were noted. It is suggested that a large number of the very short hyperfragments are very heavy. Data are presented in graphical and tabular forms. (L.N.N.)

27989 A SEARCH FOR A FREQUENCY SHIFT OF 14.4 kev PHOTONS ON TRAVERSING RADIATION FIELDS. R. Weiss (Massachusetts Inst. of Tech., Cambridge and Tufts Univ., Medford, Mass.) and L. Grodzins. Phys. Letters, 1: 342-5(July 15, 1962). (In English)

Two experiments designed to test two hypothetical $\gamma\gamma$ mechanisms for the frequency (red) shift of galactic light; a shift generally attributed to the Doppler effect from an expanding universe. Negative results were obtained, giving evidence against the energy loss of the photons from passing through the radiation fields of space or from proportionality to the photon density, independent of the radiation field frequency. (L.N.N.)

27990 SEARCH FOR ANOMALOUS SCATTERING OF MUON NEUTRINOS BY NUCLEONS. I. M. Vasilevsky, V. I. Veksler, V. V. Vishnyakov, B. Pontecorvo, and A. A. Tyapkin (Joint Inst. for Nuclear Research, Lab. of Nuclear Problems, Dubna, USSR). Phys. Letters, 1: 345-7(July 15, 1962). (In English)

A search for a high-energy neutrino-nucleon anomalous interaction was conducted in connection with a model by I. Yu. Kobzarev and L. B. Okun' (J. Exptl. Theoret. Phys., 41: 1205(1961)). Anomalous ν_μ-N scattering was investigated; since the maximum permissible value for the relevant cross section is larger by several orders of magnitude than the expected weak-interaction cross section, neutrino beams of relatively low intensity and a "ν_μ detector" of comparatively small mass were used. The ν_μ and $\bar{\nu}$ were produced during the decay in flight of π^+ generated in a synchrotron internal target by a 10-Bev proton beam. The upper limit of the count using the accelerator showed that the cross sections for the reactions $N + N \rightarrow \mu^+ + \mu^0 + N' + N'$ and $\mu^0 + N \rightarrow \mu^+ + N'$ must be smaller than typical strong interaction cross sections by at least four orders of magnitude. The importance of lowering the upper limit of the ν-N scattering cross section is discussed. (L.N.N.)

27991 REACTION $p + p \rightarrow \pi^+ + p + n$ AT 405 Mev. R. L. McIlwain, K. J. Deahl, M. Derrick, J. G. Fetkovich, and T. H. Fields (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 127: 239-44(July 1, 1962).

The azimuthal asymmetry of pion production in the reaction $p + p \rightarrow \pi^+ + p + n$ was measured using the 53% polarized 405-Mev proton beam from a synchrocyclotron. Pions produced in a liquid hydrogen target were successively detected on the left and on the right from their stopping and subsequent $\pi\mu e$ decay in a 6-in. propane bubble chamber. Elastically scattered protons were used to monitor the incident beam intensity. The pions which stopped in the chamber had an average momentum of 0.52 μc and center-of-mass production angles between 80 and 105°. The observed pion asymmetry is $|\epsilon| = (20 \pm 6.5)\%$, in the same direction as the previously observed asymmetry for the (pp,π^+d) reaction. The similarity between the observed pion asymmetry and that for the (pp,π^+d) reaction suggests that their reaction amplitudes are similar, and thus that ^3S rather than P states are predominant for the final-state nucleons in the (pp,π^+pn) reaction at this energy. The estimated total cross section (0.63 ± 0.06 mb) agrees with the calculation of Mandelstam. (auth)

27992 PERIPHERAL COLLISIONS AT ACCELERATOR ENERGIES AND THE π-π INTERACTION. E. M. Friedlaender (Inst. of Atomic Physics, Bucharest). Phys. Rev., 127: 247-51(July 1, 1962).

Measurements of inelasticity, angular distributions in the center-of-mass system, and momentum distributions at 9 and 24 Bev are interpreted in terms of peripheral collisions involving exchange of an "almost real" pion. In this energy interval the "rest masses" of the fireballs appear to be constant and close to the π-π resonances observed at lower energies. (auth)

27993 EXTRAPOLATION OF PROTON-PROTON SCATTERING DATA TO THE ONE-PION EXCHANGE POLE. E. H. Thorndike (Univ. of Rochester, N. Y.). Phys. Rev., 127: 251-3(July 1, 1962). (NYO-10035)

The dependence of p-p scattering parameters on the one-pion exchange contribution and the Coulomb scattering amplitude is investigated. Two parameters $I_0(1 - D)$ and I_0Y, have second-order one-pion poles and no Coulomb singularity in the forward direction. The extrapolation procedure frequently applied to n-p cross sections to determine the pion-nucleon coupling constant can be applied to these parameters. This is done from measurements of $I_0(1 - D)$ at 142 Mev, giving a value of $8.8^{+2.6}_{-2.6}$ for g^2, compared with the accepted value of 14. The relative sensitivity of the p-p parameters to the one-pion exchange contribution is discussed. (auth)

27994 OPTICAL MODEL ANALYSIS OF 260-Mev K^+-MESON ELASTIC SCATTERING. E. Helmy, M. A. Melkanoff, D. J. Prowse, and D. H. Stork (Univ. of California, Los Angeles). Phys. Rev., 127: 254-60(July 1, 1962).

The reaction and differential elastic-scattering cross sections were measured for K^+ mesons at 260 Mev in nuclear emulsion. Exact diffuse-surface optical model cal-

culations and χ^2 comparisons with the experimental results were made to determine the real and imaginary nuclear potential volume integrals per nucleon, $I_v + iI_w$ for the Saxon well shape with a number of choices for the shape parameters a and R_0. Good fits were obtained for a range of the shape parameters. For example, for a = 0.57 F and R_0 = 1.07 F, I_v = 145 ± 45 Mev-F^3 and I_w = 116 ± 5 Mev-F^3. Better fits are obtained for smaller values of "a," and equally good fits are obtained with R_0 = 1.20 F and the smaller "a" values. I_v and I_w are sensitive to the shape parameters a and R_0, the relationships: $I_v a^{\frac{1}{3}} R_0$ = const and $I_w a^{\frac{1}{3}} R_0$ = const, holding to within a few percent over a reasonable range of values. (auth)

27995 UNITARITY AND PRODUCTION AMPLITUDES. L. F. Cook, Jr. (Princeton Univ., N. J.) and B. W. Lee. Phys. Rev., 127: 283-96(July 1, 1962).

A development of the N/D formulation of the unitary S matrix is presented for multichannel reactions including production processes. The relevant amplitudes are expressed in terms of helicity amplitudes and the coupled, unitartiy relations of Blankenbecler. The analytic continuation of the amplitudes in the presence of anomalous thresholds is considered. An extension of the Levinson theorem to the multichannel production case is discussed. (auth)

27996 π-N SCATTERING WITH INELASTIC CONTRIBUTIONS. L. F. Cook, Jr. (Princeton Univ., N. J.) and B. W. Lee. Phys. Rev., 127: 297-311(July 1, 1962).

The N/D formulation of the unitarity S matrix, valid for reactions involving production processes, is applied to the reactions $\pi + N \rightarrow \pi + N$, $\pi + N \rightarrow \pi + \pi + N$, $\pi + \pi + N \rightarrow \pi + \pi + N$, in the energy region of the higher resonances. A model is constructed in which the two pions in three-particle states interact in only one state, and the left-hand discontinuities of the elastic and three-particle scattering amplitudes are neglected while the left-hand discontinuities of the production amplitude are approximated by a pole. The elastic amplitude is driven through unitarity by the inelastic amplitude. The general properties of this model are investigated, and the procedure is applied to the D- and F-wave scattering of the π−N system. The comparison between the experimental data and the model presented is favorable. (auth)

27997 PROBABLE EXAMPLE OF THE DECAY $\Sigma^0 \rightarrow \Lambda + e^+ + e^-$ IN NUCLEAR EMULSION. D. H. Davis, R. Levi Setti, M. Raymund, and G. Tomasini (Univ. of Chicago). Phys. Rev., 127: 605-6(July 15, 1962).

An event has been observed in nuclear emulsion which is attributed to the production of a Σ^0 hyperon and its subsequent decays via the mode $\Sigma^0 \rightarrow \Lambda + e^+ + e^-$. From the apparent concurrence of the tracks involved in the disintegrations, it has been deduced that the Σ^0 lifetime for this event is $<10^{-14}$ sec. (auth)

27998 STUDY OF THE REACTION $\pi^+ + p \rightarrow \Sigma^+ + K^+$ NEAR THRESHOLD. Fernand Grard and Gerald A. Smith (Univ. of California, Berkeley). Phys. Rev., 127: 607-13 (July 15, 1962). (UCRL-10025)

The reaction $\pi^+ + p \rightarrow \Sigma^+ + K^+$ has been studied in the momentum range 1037 through 1065 Mev/c with specific regard to the determination of s- and p-wave amplitudes. If these amplitudes near threshold are represented by $S_{\frac{1}{2}} = a_0 k^{\frac{1}{2}}$, $P_{\frac{1}{2}} + 2P_{\frac{3}{2}} = b_0 k^{\frac{3}{2}} e^{i\chi_b}$, and $P_{\frac{3}{2}} - P_{\frac{1}{2}} = c_0 k^{\frac{3}{2}} e^{i\chi_c}$, the following results have been obtained from an analysis based on 274 events: $a_0^2 = (3.31 \pm 0.87) \times 10^{-5}$ mb/sr-Mev/c, $b_0/a_0 = 0.0075 \pm 0.0026$, $c_0/a_0 = -0.0062 \pm 0.0023$, $\chi_b = 52.1 \pm 8.0$ deg, $\chi_c = 90.8 \pm 27.2$ deg. An alternative set of solutions exists for $\chi_b = -52.1$ deg and $\chi_c = 99.2$ deg. (auth)

27999 CHARGE-EXCHANGE PRODUCTION OF ANTINEUTRONS AND THEIR ANNIHILATION IN HYDROGEN. C. Keith Hinrichs, Burton J. Moyer, John A. Poirier, and Philip M. Ogden (Univ. of California, Berkeley). Phys. Rev., 127: 617-28(July 15, 1962). (UCRL-9589(Rev.); UCRL-9589(2nd Rev.))

The charge exchange of antiprotons into antineutrons and the subsequent annihilation of antineutrons have been studied in the 72-in. liquid-hydrogen bubble chamber. The antiprotons were produced internally in the Bevatron; channeled externally by collimation, quadrupole focusing magnets, and bending magnets; and separated from other negatively charged particles by a system of three velocity spectrometers. Analysis of the data for a run with an antiproton momentum of 1.61 Bev/c has been completed. Three charge exchange reactions have been studied: (a) $\bar{p} + p \rightarrow \bar{n} + n$, (b) $\bar{p} + p \rightarrow \bar{n} + n + \pi^0$, and (c) $\bar{p} + p \rightarrow \bar{n} + p + \pi^-$. The cross section for Reaction (a) plus Reaction (b) was found to be strongly peaked forward with a value for the angular differential cross section at zero degrees of 4.6 ± 0.5 mb/sr. The total cross section for these two reactions was found to be 7.82 ± 0.55 mb. The total cross section for Reaction (c) was found to be 0.99 ± 0.24 mb; the statistical model would predict the cross section for (b) to be about the same as (c). Of the antineutrons produced in reactions (a) plus (b), 122 were annihilated in the bubble chamber; the resulting annihilation cross section was found to be 45.2 ± 5.4 mb. The kinetic energy of these antineutrons was distributed such that 80% of them had energies between 800 and 1000 Mev. The average charged-pion multiplicity in the antineutron annihilations was found to be 3.5 ± 0.3. The ratio of the number of antineutron annihilations containing five charged pions to the number containing three charged pions, and the momentum distribution of the pions, have been compared with predictions of a statistical model. Reasonable agreement was obtained for a volume five times that of a sphere with a radius of one-pion Compton wave length. The center-of-mass angular distribution of the pions in the antineutron annihilations was found to be, within statistics, an isotropic distribution. Three events were found that fitted K^0-meson production in antineutron annihilation. (auth)

28000 NEGATIVE MESON ABSORPTION IN LIQUID HYDROGEN. M. Leon and H. A. Bethe (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 127: 636-47(July 15, 1962).

A theoretical study has been made of the atomic processes involved in the absorption of π^- and K^- mesons in liquid hydrogen, with the main purpose of setting an upper limit on the fraction of K mesons that react with the proton from the P state. The principal mode of de-excitation of the mesonic atom, Auger ionization of neighboring hydrogen atoms, was calculated in Born approximation for all the appropriate initial and final values of n. The Stark mixing process discussed by Day, Snow, and Sucher, which allows S-state reaction from high n orbitals, was calculated quantitatively using an impact parameter method and including the effect of the S-state energy shift. In agreement with Day et al., it was found that practically all of the K^- mesons react from the S-state; the actual fraction of P-state reactions is less than 1%. In addition, the calculated cascade time for π^- in liquid hydrogen is compatible with the experimental value. (auth)

28001 WEAK PION PRODUCTION. Norman Dombey (California Inst. of Tech., Pasadena). Phys. Rev., 127: 653-63(July 15, 1962).

The matrix element for the interaction $W + N \rightarrow \pi + N$ is studied, where W is a virtual intermediate boson for the

weak interactions (or just the weak current). Weak pion production, production of a pion by high-energy neutrino collisions with nucleons, is governed by this matrix element. The main case of interest is in the energy region where the pion-nucleon 3-3 resonance is dominant. Formulas are derived for solving the problem in this region. (auth)

28002 PION PRODUCTION IN NEUTRINO-NUCLEON COLLISIONS. Philippe Dennery (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 127: 664-70(July 15, 1962).

An evaluation of the scattering amplitude for pion production in neutrino-nucleon collisions is made assuming that the $\frac{3}{2}$-$\frac{3}{2}$ π-nucleon resonance dominates the dispersion integrals. No assumption is made concerning nucleon recoil. The vector part of the amplitude is related to the isovector part of the amplitude for electroproduction of pions by use of the Feynman–Gell-Mann conserved vector current theory. An independent calculation is given for the axial vector part of the amplitude. (auth)

28003 COVARIANT POLARIZATION ANALYSIS OF SPIN 1 PARTICLES. Arif-Uz-Zaman (Imperial Coll., London). Proc. Roy. Soc. (London), A268: 371-89(July 24, 1962).

A covariant theory of polarization analysis of spin 1 particles is developed. The 16-dimensional covariant scattering equation is reduced to the three-dimensional scattering equation. Lorentz transformations and space rotations giving rise to relativistic corrections (when the scattering theory is applied to multiple scattering experiments) are obtained. These are found to be the same as those obtained for spin $\frac{1}{2}$ particles. The spin and energy projection operators for the covariant theory are obtained, and a covariant density matrix for spin 1 "particles" is defined. (auth)

28004 UNITARY SYMMETRY IN THEORIES OF ELEMENTARY PARTICLES: THE REDUCTION OF PRODUCTS OF REPRESENTATIONS OF THE GROUPS U(3) AND SU(3). A. R. Edmonds (Imperial Coll. of Science and Tech., London). Proc. Roy. Soc. (London), A268: 567-79(Aug. 7, 1962).

Aspects of the theory of group representations relevant to the Sakata and octet models of elementary particles are discussed. The properties of the reduction coefficients, which in these theories take the place of the vector-coupling coefficients associated with isobaric spin, are enunciated. The isoscalar factors of these coefficients are tabulated for certain physically significant representations of U(3) and SU(3). (auth)

28005 THE CALCULATION OF THE CROSS SECTION FOR THE ELASTIC SCATTERING OF PARTICLES WITH SPIN. I. Brandus (Inst. of Atomic Physics, Bucharest). Rev. phys., Acad. rép. populaire Roumaine, 6: 435-440 (1961). (In French)

The elastic scattering cross section of particles with spin, initially nonpolarized, is calculated. This cross section is a particular case of the mean values obtained previously. The analysis of its concrete expression permits the explanation of the action of operators intervening in the cross section calculation. It is then shown that the general expression of the cross section is greatly simplified by being reduced to a work formula. (J.S.R.)

28006 THE DERIVATION OF THE ONE-MESON GREEN FUNCTION BY THE METHOD OF DISPERSION RELATION. Ning Hu (Peking Univ.). Sci. Sinica (Peking), 11: 1061-6(Aug. 1962). (In English)

An approximate Green function for virtual mesons is derived from the unitary condition of nucleon-antinucleon scattering. No renormalization procedure is needed. (auth)

28007 DOES A GENERALIZED PAULI EXCLUSION PRINCIPLE APPLY TO NUCLEONS AND ANTINUCLEONS? W. G. Holladay and P. H. Moravek (Vanderbilt Univ., Nashville). Phys. Letters, 1: 347-9(July 15, 1962). (In English)

A possible experimental test giving evidence for or against a generalized Pauli principle for nucleons and antinucleons. The test depends on observation of S-state, $T_3 = 0$, nucleon-antinucleon annihilation into $\pi^0\omega$ or $\pi^0\rho^0$ systems and follows from selection rules for these process based on conservation of angular momentum, parity, isospin and third component, charge conjugation, and G conjugation. Without explicitly assuming either commutation relations, N-$\overline{\text{N}}$ eigenstates of these quantities are constructed, and eigenvalues are determined for the cases in which N-$\overline{\text{N}}$ are symmetric and antisymmetric under the exchange of all the variables or coordinates of the two particles. Observation of annihilation from the symmetric states would imply that the generalized Pauli principle does not apply; observation of annihilation from antisymmetric states only would be indicative of a generalized Pauli principle for N-$\overline{\text{N}}$ systems. (L.N.N.)

28008 REGGE-POLES AND FORM FACTORS. G. Domokos and J. Wolf (Joint Inst. for Nuclear Research, Lab. of Theoretical Physics, Dubna, USSR). Phys. Letters, 1: 349-50(July 15, 1962). (In English)

By a modification of the resonance approximation for form factors (W. Frazer and J. Tulco, Phys. Rev., 117: 1609(1960)), experimental data on form factors can be used to determine Regge trajectories. Calculations are compared with data and agreement is obtained. (L.N.N.)

Neutron Physics

28009 (AECL-1504(Pts.I&II)) TABLES OF NEUTRON TRANSMISSION PROBABILITIES THROUGH PURELY ABSORBING TUBES. PART I. FORMULAS AND DESCRIPTION OF THE TABLES. PART II. TABLES. L. Pease (Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto) and N. P. Vakil (Gellman (H. S.) and Co. Ltd., Toronto). Apr. 1962. 313p.

Parts I and II may be further identified as TDS-4A and TDS-4B, respectively.

A tabulation is presented of the integrals involved in the calculation of the blackness of a purely absorbing tube which may contain a material which is largely scattering. The user has a choice of either cosine or square-of-cosine variation of the neutron in-current, and either isotropic or cosine variation of the neutron current scattered into the tube by the scattering material contained therein. The range of the independent variables is thought to be large enough that the cases of interest are covered by these tables. The series expansions and the numerical methods that were used are described. (auth)

28010 (AEEW-R-102) TRENDS IN THE TEMPERATURE DEPENDENCE OF EFFECTIVE RESONANCE INTEGRALS. A. Reichel (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Nov. 1961. 43p.

The temperature dependence of the effective resonance integral for U^{238} in uranium metal and uranium oxide lumps is shown to arise from a balance of many conflicting factors, arising principally from differing temperature behavior in resonances of different energy. If the effective resonance integral is expressed by a formula of the type

$I = AT^m + B$, then m increases as rod size decreases and with the addition of scattering material to the lump. In general m also increases with increasing temperature. For example, for small diameter uranium oxide rods, a higher value of m than that for larger uranium metal rods is to be expected. (auth)

28011 (GA-2510) NEUTRON THERMALIZATION MEASUREMENTS USING AN ELECTRON LINEAR ACCELERATOR. J. R. Beyster (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Apr. 10, 1962. Contract AT(04-3)-167. 30p.

Discussions are presented concerning integral experiments primarily on water and graphite systems. A description of experimental facilities is included along with details of die-away experiments, infinite-medium spectrum measurements, spatially dependent spectrum measurements, spectrum measurements for graphite systems, and development of a subcritical assembly program. (J.R.D.)

28012 (IDO-16749) DIFFERENTIAL SCATTERING CROSS SECTIONS OF MODERATORS IN THE SHORT COLLISION TIME APPROXIMATION. PART I. THEORETICAL. H. L. McMurry (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 30, 1962. Contract AT(10-1)-205. 43p.

A program aimed at providing differential scattering cross sections of moderators which are adequate for making reactor calculations and cover the entire range of neutron energies is discussed. There is a gap between neutron energies of 0.2 to about 1 ev where present experimental techniques are inadequate and methods for theoretical computation are imperfectly developed. An approximate computational procedure developed by Wick to calculate total scattering cross sections appears to have promise for calculating differential scattering cross sections at neutron energies well above k_BT and above the natural vibrational energies of the scattering system. Modifications were made in the Wick method and expressions were derived for the differential scattering cross section assuming the moderator is composed of semi-rigid molecules. (auth)

28013 (NP-11733) INTERPRETAZIONE TEORICA DELLE MISURE DI PARAMETRI DI DIFFUSIONE COL METODO DELLE SORGENTI NEUTRONICHE PULSATE. (Theoretical Interpretation of the Measurement of Diffusion Parameters with Pulsed Neutron Source). V. C. Boffi, V. G. Molinari, and D. E. Parks (Italy. Comitato Nazionale per l'Energia Nuclear. Laboratorio di Fisica Nuclear Applicata, Rome). May 1962. 23p. (RT/FI(62)3)

Features of the pulsed neutron source theory connected with the measurement of diffusion parameters are discussed. Various analytical procedures for determining the decay constant of the fully thermalized neutron flux are compared. The problem of the diffusion coefficient definition is also considered in some detail. (auth)

28014 (ORNL-TM-236) EFFECTIVE CUTOFF ENERGIES FOR B, Cd, Gd, AND Sm FILTERS. R. W. Stoughton and J. Halperin (Oak Ridge National Lab., Tenn.). July 27, 1962. Contract [W-7405-eng-26]. 283p.

Effective energy cutoffs have been calculated on an IBM-7090 computer for Cd, Gd, Sm, and B filters as functions of filter geometry, the ratio of Maxwellian to epithermal flux (assumed to be $1/E$), the lower energy limit of the $1/E$ flux, the energy corresponding to the Maxwellian most probable (modal) velocity and filter thickness. The geometrical configurations were spherical (which on the assumptions made is equivalent to a beam flux case), cylindrical and slab. By the use of two or three different filters (Cd and Gd and perhaps Sm) it should be possible to detect resonances in the thermal to cutoff energy regions, in addition to measuring resonance integrals and thermal cross sections of unknown nuclides. (auth)

28015 (AEC-tr-5305) ON THE POSSIBILITY OF MEASURING POLARIZATION IN NEUTRON ON NEUTRON SCATTERING. O. G. Sitenko and V. F. Kravchenko. Translated from Ukrain. Fiz. Zhur., 6: 20-3(1961). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 29988.

28016 SCATTERING OF THERMAL NEUTRONS ON CH_3NH_2 MOLECULES IN THE LIQUID STATE. A. Bajorek and S. Krašnicki (Jagellonian Univ., Krakow). Acta Phys. Polon., 11: 529-36(1962). (In English)

The total effective cross section of methylamine molecules in the liquid state with respect to thermal neutron scattering was measured from 10 to 280 Mev and at three sample temperatures. The effective cross sections were found to be independent of the temperature, but to depend on inelastic neutron scattering related to excitation of several close-lying vibrational states of the molecule. (auth)

28017 THERMAL NEUTRON SPECTRA IN GRAPHITE. D. E. Parks, J. R. Beyster, and N. F. Wikner (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nuclear Sci. and Eng., 13: 306-24(Aug. 1962). (GA-2437)

A pulsed, high-current, electron linear accelerator is used to excite thermal-neutron spectra in a graphite assembly. The steady-state energy spectra of neutrons are measured at several temperatures by pulsed-beam time-of-flight techniques. The measured spectra are compared with theoretical predictions which use free- and bound-carbon scattering kernels. The scattering kernel for carbon bound in graphite is obtained through a realistic treatment of the neutron-phonon interactions. With this kernel, theoretical calculations of spectra agree extremely well with the experimental results. Predictions derived from a scattering law in which the carbon atoms are treated as free differ markedly from the measured spectra, even up to a temperature of 810°K. Additional calculations show that the effects of chemical binding are significant in problems of reactor design physics. (auth)

28018 MEASUREMENT OF THE DIFFUSION LENGTH IN D_2O. Hans-Rudolf Lutz and Rudolf W. Meier (Eidgenossische Institut fur Reaktorforschung, Wurenlingen, Switzerland). Nukleonik, 4: 108-10(Apr. 1962). (In German)

In the exponential pile at Wurenlingen, the neutron diffusion length of D_2O was measured for four different concentrations and compared with a theoretical curve calculated from basic data. The value of $L = 136 \pm 7$ cm, extrapolated from the measurement results, for a concentration range of 100% is approximately 10% lower than the theoretical value calculated with a microscopic absolute cross section of $\sigma_a = 1.3$ mb. An increase of this cross section by about 0.2 mb would greatly improve the agreement. (tr-auth)

28019 CALCULATION OF THE TOTAL EFFECTIVE CROSS SECTION FOR THE SCATTERING OF SUBTHERMAL NEUTRONS IN WATER AND ICE BY A CRYSTAL MODEL. Gerhard Goessmann (Technische Hochschule, Munich). Nukleonik, 4: 110-22(Apr. 1962). (In German)

The model used with success by Nelkin for the calculation of the total effective cross section of water for neutrons with incident energy between 10 Mev and 1 ev (in which the translational motion of the molecule was considered as unhindered) was extended for small neutron energies by considering the hindrance by translational motion in a Debye crystal model. For ice the same model with altered pa-

rameters was used. The theory was compared with the measurements of Heinloth for incident energies of 2.7, 0.78, and 0.18 Mev. The gas model is valid with good approximation in water and ice at 2.7 Mev. At 0.78 and 0.18 Mev fair agreement between theory and experiment was obtained for ice when a Debye temperature of 300°K was used. The scattering in water can be calculated between 0 and 20°C with a Debye temperature of about 220°K. Above 20°C, the rise of the experimental curve is much steeper than that of the theoretical curve. Formally this can be described when one assigns to the water between 20 and 100°C a Debye temperature decreasing from 220 to 60°K. The sharp increase of the experimental effective cross sections originates probably in a great measure from the diffusion motion of the water molecule sharply increasing with increasing temperature. An interpretation of the measurement results into a "hump model" of the water yields between 0 and 100°C a decrease of the portion of the ice-like bound molecule from about 75 to 20%. (tr-auth)

28020 MATHEMATICAL PRINCIPLES OF A GENERALIZED MULTIGROUP THEORY. Friedrich Stummel (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 4: 137-48(Apr. 1962). (In German)

The multigroup theory in its familiar form permits an obvious generalization. This was defined in the first part for the transport theory and the diffusion theory. It was then shown that in the case of the one-dimensional generalized diffusion theory the boundary value problem is soluble through a method which represents a translation of known methods. In conclusion a numerical approximation of the equations given was carried out and the recursive relationships for the calculation of the solutions sought were given in detail. (tr-auth)

28021 TWO POWERFUL NEUTRON GENERATORS FOR PULSED AND PERMANENT OPERATION. Werner Eyrich (Kernforschungszentrum, Karlsruhe, Ger.). Nukleonik, 4: 167-74(June 1962). (In German)

The construction and method of operation of two powerful neutron generators are reported. The generators use the d,T) reaction with deuterons which are accelerated to 250 or 400 kv. The general structure, construction of the ion source, and the acceleration gap are described. The generators have at their disposal special pulse devices for the ion current, whose mode of operation is discussed. The instantaneous source intensity of the generators is 5×10^{12} neutrons/sec. (tr-auth)

28022 RESONANT ABSORPTION OF NEUTRONS BY CRYSTALS. H. E. Jackson and J. E. Lynn (Argonne National Lab., Ill.). Phys. Rev., 127: 461-8(July 15, 1962). (UAC-6187)

A study has been made of the Doppler broadening of resonances in the total cross section for interaction of slow neutrons with nuclei bound in crystals. The resonance at 6.71 ev in Os metal and the resonance at 6.65 ev in U metal were chosen as examples of moderate crystal binding, while the 6.65-ev resonance in U_3O_8, for which $k\theta_0$ = 1.043 ev, was chosen as an example of strong binding. The shapes of the resonance lines were determined as a function of temperature by measuring the neutron transmission of thin and thick samples by means of the Argonne fast chopper. These shapes were compared with theoretical line shapes calculated by means of Lamb's theory of Doppler broadening as applied to the spectra of lattice frequencies implied by simple models of the crystal lattices. For moderate binding, a simple Einstein model which reproduces the observed specific-heat behavior of the crystal above 40°K gives accurate resonance-line shapes at all temperatures. However, for U_3O_8 the line shape implies a generalized Nernst-Lindemann model of the lattice with a frequency spectrum $g(\nu) = 0.9\ \delta(h\nu_1 - 0.013\ ev) + 0.1\ \delta(h\nu_2 - 0.052\ ev)$. The proportions of the high- and low-frequency components are quite different from the values resulting from specific-heat data. Possible interpretations of the U_3O_8 results in terms of simple lattice models are presented. (auth)

Nuclear Properties and Reactions

Refer also to abstract 28417.

28023 (AFOSR-2254) THEORY OF THE X-RAY K ABSORPTION SPECTRUM OF ARGON. Research Report No. 12. Takeshi Watanabe (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). Apr. 10, 1962. Contract AF 49(638)-402. 15p.

The oscillator strengths of 1s → 4p and 1s → 5p x-ray transitions in atomic argon were calculated by using Hartree-Fock wavefunctions. It was assumed that the effect of the 1s-hole is to reduce electronic screening by unity so that the final orbital of the ejected electron is essentially that in a simply excited potassium atom, the remaining electrons retain essentially their respective radial positions before and after production of the 1s-hole, and the coupling between the 1s-hole and the 4p or 5p electron is small. The oscillator strengths, based on the dipole moment expressions, were found to be 0.0016 for the 1s → 4p and 0.00053 for the 1s → 5p transitions respectively. Experimental values, viz., 0.0018 and 0.00057, are in good agreement, although the reality of the assumptions made is not clear in view of the very short life time of the K state of argon. (auth)

28024 (ARF-1193-12) SCINTILLATION SPECTROMETER MEASUREMENTS OF CAPTURE GAMMA RAYS FROM NATURAL ELEMENTS. Quarterly Report, March 15, 1962 to June 14, 1962. Reginald C. Greenwood and John H. Reed (Illinois Inst. of Tech., Chicago. Armour Research Foundation). July 20, 1962. Contract AT(11-1)-578. 53p.

Neutron capture gamma spectra of naturally occurring elements, in both the low and the high energy spectral region, were made using NaI(Tl) crystals as detectors. A compilation of spectra was made to evaluate possible practical applications of neutron capture gamma techniques. Toward this end, efforts were expended in obtaining suitable low energy capture gamma spectra for inclusion in the Atlas. Low energy capture spectra were obtained for Sc, Ti, V, Mn, Ni, Cu, As, Se, Y, Nb, La, Pr, Nd, Sm, En, Gd, Tb, Er, Ta, W, and Hg, with the 1½ in. × 1 in. NaI(Tl) crystal, and for Ti, V, Ni, Cu, As, Se, Y, Nb, Cd, La, Pr, Ta, and W with the 3 in. × 3 in. NaI(Tl) detector. (auth)

28025 (CEND-146) AN EVALUATION OF EFFECTIVE PLUTONIUM CROSS SECTIONS IN REACTIVITY CALCULATIONS. E. Fein and L. C. Noderer (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Sept. 30, 1961. Contract AT(30-1)-2379. 32p.

The fairly general use of Westcott's scheme for obtaining one-group effective cross sections especially for calculating long-term reactivity changes for low enriched U-fueled reactors motivated a comparison with MUFT and SOFOCATE. The apparently better agreement with Pu critical experiments that Westcott's method yields is traced to his better Pu^{239} thermal cross sections. The limitations of his method for drier and hence more epithermal

spectrum cores is analyzed. Suggestions for improving the SOFOCATE, and in particular the CANDLE cross sections, are made. The practical effect of Westcott's method in predicting increased long-term reactivity is illustrated. It is concluded that Westcott's scheme is adequate for well-moderated reactors but that his epithermal α values are too optimistic and hence for drier lattices the MUFT-SOFOCATE method should be used. (auth)

28026 (IDO-16699(Rev.)) COMPILATION OF REDUCED SLOW NEUTRON PARTIAL DIFFERENTIAL SCATTERING CROSS SECTIONS. Robert M. Brugger (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 2, 1962. Contract AT(10-1)-205. 27p. (TNCC-US-21 (Rev.); EANDC-US-25)

Reduced partial differential cross section curves are presented for Be, BeO, graphite, H_2O, D_2O, methane, propane, o-, m-, and p-terphenyl, Santowax-R, and an ideal gas. The cross sections are presented as a set of smoother curves for discrete values of $\hbar\omega$ as a function of $|\vec{K}|$. Each curve is indexed by a value of ϵ; the magnitude in ev of the $\hbar\omega$ steps are obtained from the simple relation between ϵ and $\hbar\omega$. (P.C.H.)

28027 (JINR-D-988) MEASUREMENT OF THE $\mu^- + He^3 \rightarrow H^3 + \nu$ REACTION RATE. I. V. Falomkin, A. I. Filippov, M. M. Kulyukin, B. Pontecorvo, Yu. A. Scherbakov, R. M. Sulyaev, V. M. Tsupko-Sitnikov, and O. A. Zaimidoroga (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 8p.

The reaction $\mu^- + He^3 \rightarrow H^3 + \nu$ was investigated. A magnetic diffusion chamber filled with He^3 at 20 atm was placed in the 217 Mev/c beam of the Dubna 680 Mev synchrocyclotron. Since the tritium produced in the reaction has a definite energy, the problem of identifying events of the reactions consists of selecting a group of one-prong stars with the corresponding energy range from the background due to other processes. The reaction rate was determined to be $1.36 \pm 0.18 \times 10^3$ sec^{-1}. This agreed with the rate predicted by the universal theory within the accuracy of the experiment. (M.C.G.)

28028 (JINR-E-918) PROPERTIES OF THE GROUND- AND EXCITED STATES OF STRONGLY DEFORMED NUCLEI. V. G. Solov'ev (Soloviev) (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 17p.

The calculations of the even-even nuclei energies and the probabilities of the β-transitions in even and odd nuclei carried out on the basis of the superfluid nuclear model in the regions $154 \leq A \leq 188$ and $225 \leq A \leq 255$ were summarized. The properties of the ground- and excited states of strongly deformed nuclei which follow from the superfluid model of the nucleus were investigated. Experiments were suggested with the indication of the most favorable cases of finding three- or four-quasi-particle states being populated for appropriate β-decays. Attention was paid to the necessity of the experimental finding of all levels of the even-even nuclei given by the model. It is shown that the experimental determination of the degree of the F-forbiddenness of the β-decays will point out how the residual forces which are not taken into account in the superfluid model affect the properties of the ground- and excited states. All the even strongly deformed nuclei were analyzed, and the cases were pointed out which are the most favorable for determining the degree of the F-forbiddenness of the β-transitions. (auth)

28029 (JINR-E-952) ANALYTIC PROPERTIES OF THE ELASTIC $\pi\pi$ SCATTERING AMPLITUDE IN THE l PLANE. G. Domokos (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1962. 4p.

It was shown that if the partial wave amplitudes of elastic $\pi\pi$ scattering were meromorphic functions of l, then the results of Regge (Nuovo cimento, 14: 951(1959)) obtained in the framework of quantum mechanics can be carried over to field theory without any appreciable difficulty. An analysis of these analytic properties is presented. (J.R.D.)

28030 (JINR-P-996) PROSTYE YADERNYE REAKTSII NA Ca^{48} POD DEISTVIEM PROTONOV VYSOKIKH ENERGII. (Simple Nuclear Reactions on Ca^{48} Induced by High Energy Protons). I. Levenberg, V. Pokrovskii, and I. Yutlandov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1962. 10p.

The reactions (p,pn), (p,2n), and (p,n) on Ca^{48} were investigated in the proton energy range of 120 to 660 Mev. The cross section for (p,pn) reaction is weakly dependent on the proton energy and amounts to 105 mbs. The cross sections for (p,2n) and (p,n) reactions increase with the proton energy from ~20 and ~8 mbs at 120 Mev down to ~6 and ~2 mbs at 660 Mev, respectively. The dependencies of the ratios $\sigma_{p,2n}/\sigma_{p,n}$ and $\sigma_{p,pn}/\sigma_{p,n}$ on the proton energy and on the mass number of the nucleus target was determined. The mechanisms of (p,n) reaction and of the first stage of (p,2n) are the same. The contribution of the direct neutron knocking to the cross section of (p,pn) reaction prevails in the proton energy range of the order of hundreds of Mev. (auth)

28031 (LA-2714) A THEORY OF NEUTRON REACTIONS OF Li^6. Charles L. Critchfield (Los Alamos Scientific Lab., N. Mex.). June 7, 1962. Contract W-7405-eng-36. 76p.

The predictions of a theory of neutron reactions on Li^6 are worked out and compared with experimental results with neutrons up to 14 Mev. The levels of the lithium nuclei involved are simulated by p^n-configurations of independent particle orbits with L-S coupling. Formation of compound nuclear states, direct knock-on, and pickup processes are considered. One of the purposes is to determine whether other mechanisms are required, such as would be possible in a cluster model, for example. The results indicate that formation of compound states accounts for about half of the magnitudes of observed cross sections. Direct collisions are of comparable importance to n-t and n-2np reactions, and pickup appears to be adequate to account for the balance of the n-dn cross sections. The angular distribution in the latter was examined, but did not prove to be decisive. Additional mechanisms for the n-He^6 and the formation of the 2.2 Mev excited state of Li^6 appear to be required. (auth)

28032 (NP-11631) TOTAL EFFECTIVE NEUTRON CROSS SECTION OF As, Sb, Se, AND Te AT 0.0027 AND 0.001 ev. D. Balli, Z. Georgiu, and T. Stadnikov (Academia R. P. R. Institutul de Fizica Atomica, Bucharest). 1962. 16p. (In Rumanian)

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 24811.

28033 (NP-11833) NERELYATIVISTSKIE FEINMANOVSKIE DIAGRAMMY I PRYAMYE YADERNYE REAKTSII. (Non-relativistic Feynman Diagrams and Direct Nuclear Reactions). L. D. Blokhintsev, Z. I. Dolinskii, and V. C. Popov (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki). 1962. 32p.

An integral concept of arbitrary non-relativistic diagrams was developed that is analogus to the Chisholm-Nambu relativistic concept. Equations were derived for

finding special points in the non-relativistic diagram, and analytic properties of single-contour diagrams were examined. An explicit expression was derived at constant apex for triangular amplitude at arbitrary mass for virtual particles. An invariant kinematic description is given for nuclear reactions of the type A(x,y)B in the non-relativistic region. The closest special nuclear reaction amplitude points were found in order to determine the mechanism of the examined reactions. (tr-auth)

28034 (PUC-1962-71) β-γ CIRCULAR-POLARIZATION MEASUREMENTS OF Sc^{46} AND Fe^{59} (thesis). Ernst L. Haase (Princeton Univ., N. J. Palmer Physical Lab.). May 1962. Contract AT(30-1)-937. 108p.

Using a small long-coil β spectrometer and the standard method of forward Compton scattering off a cylinder of magnetized iron, the circular polarization anisotropy A was measured for Co^{60}, Na^{22}, Sc^{46}, and Fe^{59}. The calculations for the β-spectrometer and a detailed efficiency calculation for the photon polarimeter are given. Various corrections are discussed in detail. The results of A = -0.3144 ± 0.019 for Co^{60} and A = +0.312 ± 0.026 for Na^{22} are in agreement with the theoretical value of 1/3 and serve as a check on the efficiency calculations. The result for Sc^{46} is A = +0.079 ± 0.013, in agreement with Bloom, Mann and Miskel, and Daniel and Kuntze. However the disagreement of this value with earlier results can probably be explained by chemical effects, as indicated by results obtained by Boehm after completion of this work. A = -0.066 ± 0.037 was measured for the 462 kev branch in Fe^{59}. This value implies that the spin assignment to the 1.1 Mev state in Fe^{59} should probably be changed to $3/2^-$. The result for the 271 kev branch is A = -0.40 ± 0.20. If the proposed spin assignment is valid, then for both branches a considerable violation of the isotopic spin selection rule is indicated. The values for both branches are in disagreement with results by Forster and Sanders. (auth)

28035 (TID-15332) STRIPPING ANALYSIS OF THE (d,p) ANGULAR DISTRIBUTIONS FROM THE $Cl^{35}(d,p)Cl^{36}$ AND THE $Cl^{37}(d,p)Cl^{38}$ REACTIONS. A. M. Hoogenboom, E. Kashy, and W. W. Buechner (Massachusetts Inst. of Tech., Cambridge). [1961]. Contract [AT(30-1)2098]. 45p.

Analysis of the angular distribution of the protons from the $Cl^{35,37}(d,p)Cl^{36,38}$ reactions revealed 46 levels in Cl^{36} and 4 levels in Cl^{38} which were previously unreported, and the absolute differential cross sections for 50 groups to levels in Cl^{36} and for 7 groups in Cl^{38}. The discussion is presented in terms of the shell model. (J.R.D.)

28036 (TID-16059) AVERAGE RESONANCE PARAMETERS NEAR A = 100 (thesis). Aaron Keith Furr (Duke Univ., Durham, N. C.). 1962. 116p.

Previous attempts to obtain average resonance parameters from analyses of capture cross section measurements have had limited success because these measurements did not extend over a sufficiently broad energy region and because no very satisfactory method of normalizing the results to obtain absolute values was employed. An indirect method which avoids both of these difficulties is presented. Activation experiments were carried out for Zr^{96}, Mo^{98}, Mo^{100}, Rh^{103}, Ag^{107}, Ag^{109}, In^{115}, I^{127}, and Au^{197} with a beam of pile neutrons filtered by B^{10} absorbers of varying thicknesses. An analysis was made of the shapes of the activation curves as a function of the thickness of the B^{10}, corrected for neutrons scattered from the beam and for the contribution of neutrons with energies greater than 100 kev, to obtain the average resonance parameters. Average s- and p-wave γ-ray strength functions $(\Gamma_\gamma/D_o)_l$ and neutron strength functions (Γ_n^l/D) were obtained by using known thermal activation cross sections and the γ-ray strength function of I^{127} as a standard. Resonance integrals relative to that of I^{127} were also obtained. Neutron capture cross sections for neutron energies up to 200 kev were predicted from the above average resonance parameters. These cross sections generally agree well with the shapes of previously reported experimental capture cross sections measured by activation techniques. The p-wave neutron strength functions (Γ_n^1/D) derived from the analysis of our activation curves confirm the indication that the p-wave giant resonance, predicted near A = 100 by the simple optical model, is split into a $P^{3/2}$, $P^{1/2}$ doublet by a strong spin orbit coupling potential. We are encouraged by the agreement with the previous results and feel that B^{10} absorption technique was shown to be a valid and useful method for obtaining average resonance parameters in the energy region from a few hundred ev to about 200 kev. (auth)

28037 (UCRL-10245) INVESTIGATION OF ELECTRONIC AND NUCLEAR PROPERTIES OF SOME RARE EARTH ISOTOPES (thesis). Burton Budick (California. Univ., Berkeley. Lawrence Radiation Lab.). May 23, 1962. Contract W-7405-eng-48. 95p.

Electronic and nuclear properties of several rare earth isotopes were investigated with the atomic-beam magnetic resonance technique. The spins of Ho^{161}, Er^{165}, Pr^{143}, and Nd^{149} were found and are tabulated. From the J-level assignment for holmium and its measured g_J value, an electronic configuration of $4f^{11}6s^2$ is inferred. The magnetic dipole and electric quadrupole interaction constants were measured for Pm^{147} and Pm^{151}. A best-fit value for g_J was also found in analyzing the data on promethium isotopes and values for the nuclear moments were deduced. An interpretation of the results as well as a description of the technique used to obtain them is given. (auth)

28038 (CEA-tr-X-448) LIMITE SUPÉRIEURE DU SPECTRE ÉNERGÉTIQUE DES FRAGMENTS LÉGERS ÉMIS LORS DE LA FISSION DE L'U-235 PAR DES NEUTRONS THERMIQUES. (Maximum Limit of the Light Particle Spectrum from the Fission of U-235 by Thermal Neutrons). J. Catalá, J. Casanova, V. Domingo, F. Senent, E. Villar, and R. Font. Translated into French from Anales real soc. espãn. fís. y quím. (Madrid), Ser. A 56: 39-42(Jan.-Feb. 1960). 12p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 19802.

28039 SPINLESS INTERACTION OF SLOW NEUTRONS WITH A PARTICULAR TYPE OF RECTANGULAR COMPLEX CAVITY. J. K. Kowalczyński (Warsaw Univ.). Acta Phys. Polon., 11: 549-51(1962). (In English)

A sphere is considered that has a potential V given by $V = V_0$ = constant for $0 \leq r \leq R_0$ and $V = V_1 (1 + \xi i)$ = constant for $R_0 < r \leq R$, where R is the characteristic range of nuclear forces. Generally, $V_0 \neq V_1$. The Schrödinger equation for the interaction of this sphere with slow neutrons is derived. The total, elastic, and inelastic cross sections for scattering are calculated for two cases, $\xi > 0$ and $\xi = 0$. In the first case, the potential reproduces the v^{-1} dependence of the total and inelastic cross sections. In the second case, the inelastic cross section is zero and the total and elastic cross sections are constant and equal. This latter behavior is observed in a large number of isotopes. (T.F.H.)

28040 CALCULATION OF THE OPTICAL POTENTIAL WITH THE NUCLEON-NUCLEON PHASE SHIFTS IN THE

THOMAS-FERMI APPROXIMATION II. Małgorzata Zielińska and Adam Sobiczewski (Warsaw Univ. and Warsaw Technical Univ.). Acta Phys. Polon., 21: 423-7(Apr. 1962). (In English)

The radial dependence of the optical potential for nucleon-nucleus scattering is calculated using the empirical nuclear density. The nucleus is approximated locally by the Fermi model. The equation for the scattering in the nuclear medium is solved approximately, and the optical potential is expressed using nucleon–nucleon phase shifts. In the numerical computations, the latest Yale phase shifts are used. In comparison with the analogical calculation based on the Signell-Marshak phase shifts, the radius and the surface thickness of the real and the imaginary part of the optical potential practically do not change; depths of the optical potential increase a little (less than 8%, i.e., less than 2 Mev) for the imaginary part and up to 35%, i.e., up to 15 Mev, for the real part, in the center of the nucleus. (auth)

28041 BRANCHING RATIO IN THE DECAY OF K^{42}. Boerje Persson (Univ. of Lund, Sweden). Acta Radiol., 58: 192-200(June 1962). (In English)

The beta spectrum of K^{42} was investigated and it was found that (17.9 ± 0.5)% of the beta disintegrations are accompanied by a gamma transition in Ca^{42} with an energy of 1.5 Mev. An anthracene scintillation spectrometer was used as beta detector and operated in coincidence with a sodium iodide scintillation spectrometer in determining the number of beta particles in coincidence with gamma rays. (auth)

28042 CONTRIBUTION TO THE STUDY OF (p,pn) REACTIONS AT MEDIUM ENERGY. Mark Gusakow (Laboratoire Joliot-Curie, Faculte des Sciences, Paris). Ann. phys., 7: 67-100(Jan.-Feb. 1962). (In French)

The excitation functions of (p,pn) reactions in F, Na, Mn, Y, Cs, and Au at 20 and 150 Mev were studied. The cross sections were measured in absolute values by classical γ spectrometry, and the results, in agreement with other measurements, are much superior to theoretical predictions based on the models actually used. A theoretical interpretation was attempted by the following processes: Coulomb excitation followed by neutron evaporation, "pick-up," and the Serber two-stage model. The first two mechanisms give a very slight contribution, especially above 50 Mev. Only the Serber model is in qualitative agreement with experimental results. The direct interaction calculations made at Los Alamos were used, and the evaporation phase was calculated with an IBM-650 computer. The introduction of "pairing" energies permits pure evaporation to be taken into account in a satisfactory fashion. The direct interaction seems underestimated in the Los Alamos calculations, and an evaluation of the effects of an improved diffuse nuclear surface sharply improves experiment-theory accord. Complete calculations made with this hypothesis and a consideration of possible nuclear substructures makes this model much more realistic. A systematic study of the cross sections of (p,pn) reactions at 100 and 400 Mev has shown that at these energies the most important process seems to be a direct surface interaction produced in foils with thickness about 1.5 times the mean free path of protons in the nuclear matter. (tr-auth)

28043 A UNIFIED THEORY OF NUCLEAR REACTIONS. [PART] II. Herman Feshbach (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.), 19: 287-313(Aug. 1962).

The effective Hamiltonian method for nuclear reactions described in an earlier paper is generalized so as to include all possible reaction types, as well as the effects arising from the identity of particles. The principal device employed is the projection operator which selects the open channel components of the wave function. It is found that the formal structure providing a unified description for direct and compound nuclear reactions including the coupled equation description for direct reactions remains valid in this wider context. A Kapur-Peierls expansion may also be readily obtained. The concept of channel radii is not needed nor is any decomposition of the wave function for the system into angular momentum eigenstates required, so that the expressions for transition amplitudes and widths are invariant with respect to the angular momentum coupling scheme. Since the open channels can only be defined in an asymptotic sense, the corresponding projection operators are not unique. As a consequence the projection operator method has a flexibility which in the first place is consonant with the wide range of phenomena which can occur in nuclear reactions and in the second place can effectively exploit an intuitive understanding of the phenomena. Example of projection operators are obtained including one which leads to the Wigner-Eisenbud formalism, another which is appropriate for the stripping reaction, and, finally, one which takes the Pauli exclusion principle into account. Note that explicit representations of the projection operators are not required for the development of general formal results but are necessary if, eventually, quantitative calculations are made. (auth)

28044 ELASTIC SCATTERING OF 14 Mev NEUTRONS AT SMALL ANGLES. G. Deconninck, A. Martegani, J. P. Meulders, and J. Stoquart. Ann. soc. sci. Bruxelles. Ser. I, 75: 102-5[1961]. (In French)

Small-angle elastic scattering cross sections were measured for 14-Mev neutrons on Fe, Zn, Cu, Cd, Sn, Pb, Bi, and U^{238}. Magnetic coupling, polarizability, and atomic electron collisions may be responsible for a cross-section increase in the forward direction. Results indicate unexpected behavior for Fe, Zn, and Cu. (auth)

28045 MAGNETIC RESONANCE IN RADIATING OR ABSORBING ATOMS. F. Bitter (Massachusetts Inst. of Technology, Cambridge). Appl. Opt., 1: 1-10(Jan. 1962).

Investigation of atomic energy levels using magnetic resonance techniques is discussed. A review is presented of some of the studies of atomic vapors in connection with level structures and the mutual interactions of light oscillating magnetic fields and the effects of collisions. (auth)

28046 DYNAMIC POLARIZATION OF NUCLEI. J. Uebersfeld (Universite. Besancon, France). Arch. sci. (Geneva), 14: 456-72(Sept. 1961). (In French)

An outline is given of experimental methods and results in dynamic polarization of nuclei. The experiments are characterized by the application of a strong magnetic field in order to saturate bound electronic resonances, and by the use of a weak magnetic field to analyze the populations of the nuclear Zeeman sub-levels. A review is given of the definition of dynamic polarization in the case of spin $\frac{1}{2}$; of the different types of interactions possible between electronic and nuclear magnetic moments; and of the effects of these interactions on the proper states of the spin systems. A statistical approach is described that allows a qualitative analysis of the dynamic polarization phenomena observed. The possibility of making quantitative studies of these phenomena is noted. Some applications of the experimental methods considered are enumerated. (T.F.H.)

28047 UTILIZATION IN NUCLEAR PHYSICS OF CROSS SECTION PROPERTIES OF REACTIONS IN THE VICINITY OF THEIR SINGULARITIES. J. Ruelle-Lardinois (Univer-

ané Libre, Brussels). Bull. classe sci., Acad. roy. Belg., (5) 48: 73-86(1962). (In French)

The method developed by Chew and Low for the study of scattering by unstable particles can be applied to nuclear physics. The nonrelativistic cross section for simply connected graphs with one intermediate line and two incoming and two outgoing particles is calculated. The connection of these graphs to stripping, heavy particle stripping, and pick-up reactions is emphasized. The extrapolation of the cross section of these reactions is shown to give indications on single-particle widths of nuclear bound states and on the existence of cluster states in the reacting nuclei. (auth)

28048 THE DEFINITION OF NUCLEAR PHASE SHIFTS FROM EXPERIMENTS ON THE ELASTIC SCATTERING OF CHARGED PARTICLES. Jean Reignier (Université Libre, Brussels). Bull. classe sci., Acad. roy. Belg., (5) 48: 179-86(1962). (In French)

The quasi-nuclear phase shifts obtained from elastic scattering experiments with charged particles are corrected in order to derive true nuclear phase shifts (i.e., phase shifts corresponding to fictitious neutral particles with the same strong interaction properties). At a given energy, the correction is made by relating each nuclear phase shift to a "nuclear plus Coulomb" potential whose Coulomb part is then eliminated by a first order perturbative calculation in $\alpha/a = Z_1Z_2e^2/\hbar v$). In this calculation, a simple representation of the regular and irregular Coulomb wave functions, which is correct to order a, is used. The discussion of an example shows that in the case of $\pi-N$ scattering, this correction can still be neglected at the present time. (auth)

28049 ISOMERIC STATES OF Ag^{109}, In^{115}, AND Sb^{119}. W. White and W. M. Martin (McGill Univ., Montreal). Can. J. Phys., 40: 865-78(July 1962).

The internal beam of a 100-Mev proton synchrocyclotron is used in conjunction with a rapid target extraction unit to study isomers of a few seconds' half life. (auth)

28050 BRANCHING RATIO IN THE DECAY OF Be^7. J. G. V. Taylor and Janet S. Merritt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 40: 926-9 (July 1962).

Be^7 decays to Li^7 by electron capture, with a half life of 53.6 days. The branching ratio for decay to the 477-kev state in Li^7 is measured to be (10.32 ± 0.02)%. This value is found by coincidence counting of Auger electrons and 477-kev gamma rays. (T.F.H.)

28051 INTERNAL CONVERSION ELECTRON SPECTRUM FROM THE DECAY $Tb^{161} \rightarrow Dy^{161}$. Andrée Juillard and Claude Boublil (Centre d'Études Nucléaires, Grenoble, France). Compt. rend., 254: 3845-7(May 28, 1962). (In French)

The internal conversion electrons of Dy^{161} were studied with a double-focusing β spectrometer, without iron, in order to confirm the existence, the energy, and the nature of the associated γ transitions. The results obtained for the 57.10 and 74.55 kev transitions are in agreement with the theoretical model calculated by Bès. (tr-auth)

28052 ELECTRON BEAM SPECTRA EMITTED DURING THE ISOMERIC TRANSITIONS OF MERCURY-193 AND THE TRANSMUTATION OF MERCURY-193 INTO GOLD-193. José Sant'Ana Dionisio (Centre National de la Recherche Scientifique, Orsay, France). Compt. rend., 254: 3851-3 (May 28, 1962). (In French)

The electron beam spectra emitted during the isomeric transition of Hg^{193} and the transmutation $Hg^{193} \rightarrow Au^{193}$ were studied with two semicircular focalization magnetic spectrographs (with a preacceleration) in the energy interval from 0 to 116 kev and from 116 to 304 kev, respectively. (tr-auth)

28053 PRECISE MEASUREMENTS OF SOME α ENERGIES IN THE FAMILY OF THORIUM X (RADIUM-224). Geneviéve Bastin-Scoffier (Centre National de la Recherche Scientifique, Orsay, France). Compt. rend., 254: 3854-6 (May 28, 1962). (In French)

A measurement by magnetic spectrometer of the α energies for ThX and its derivatives has given the following results (in kev): ThX α_0, 5684.0 ± 1.2; ThX α_1, 5447.2 ± 1.2; thoron, 6288.4 ± 2.0; ThA, 6777.2 ± 1.2. (tr-auth)

28054 PECULIAR PROPERTIES OF SOME NEUTRON TRANSMISSION RESONANCES SHOWN BY NUCLEI OF THE MIDDLE REGION. Jean Julien, Charles Corge, Vinh-Dinh Huynh, Joseph Morgenstern, and Francis Netter (Centre d'Etudes Nucléaires, Saclay, France). Compt. rend., 254: 4009-11(June 4, 1962). (In French)

The time-of-flight study of transmission resonances possessed by As and Se for neutrons with energy below 2 kev and by Zr for neutrons below energy 5 kev makes evident some statistical peculiarities of Se resonances and defines the isotopic assignment of Zr resonances. (tr-auth)

28055 MULTI-DIMENSIONAL ANALYSIS OF RADIATIONS EMITTED DURING THE RESONANT CAPTURE OF NEUTRONS IN VARIOUS NUCLEI. Jean Julien, Vinh-Dinh Huynh, Joseph Morgenstern, and Francis Netter (Centre d'Etudes Nucléaires, Saclay, France). Compt. rend., 254: 4162-4(June 13, 1962). (In French)

The first utilization of a time-of-flight multi-dimensional selector with 64,000 channels shows the possibilities of this apparatus for the study of the characteristics of resonant capture of neutrons by nuclei. Typical examples in isotopic assignment of resonances, spin determination, and study of p-type resonances are given. Preliminary results obtained on Nd^{143}, Nd^{145}, Pt^{195}, and Pt^{198} are shown graphically. (J.S.R.)

28056 SYSTEMATIC DETERMINATION OF THE PARAMETERS OF NEUTRON TRANSMISSION RESONANCES BY VARIOUS NUCLEI. Charles Corge, Genevieve Bianchi, Vinh-Dinh Huynh, Jean Julien, Joseph Morgenstern, and Francis Netter (Centre d'Etudes Nucléaires, Saclay, France). Compt. rend., 254: 4287-9(June 18, 1962). (In French)

By use of the IBM 7090 calculator, the parameters of the transmission resonances of the Pt isotopes 195, 198, 196, and 194 can be determined. Preliminary results are also given for Mo. (tr-auth)

28057 ALPHA-GAMMA ANGULAR CORRELATION MEASUREMENTS WITH LIQUID SOURCES. Elias Smith Murphy, Jr. (Colorado State Univ., Fort Collins). Dissertation Abstr., 22: 3236(Mar. 1962).

Alpha-gamma angular correlation measurements were made with solid sources of Am^{242} and with liquid sources containing either Am^{243} or an even-even alpha emitter in dilute perchloric acid solutions. Even-even alpha emitters studied were U^{232}, Th^{230}, and Ra^{226}. Thicknesses of the solid sources were controlled so that the neptunium recoils from one source were stopped in Am_2O_3 while recoils from the other sources were stopped in the aluminum, gold, or mica backing on which the sources were vaporized. The light sources were films consisting of 3 microliters of solution placed between a rubber hydrochloride membrane and a microscope cover glass 1 cm^2 in circular cross section. The perchloric acid concentration of the liquid sources ranged from 0.5 to 3.0 molar. All of the angular correlations obtained with solid Am^{243} sources were attenuated, the average attenuation coefficients being

0.29 ± 0.01 for sources in which recoils were stopped in Am_2O_3, 0.20 ± 0.01 for sources in which recoils were stopped in mica, 0.52 ± 0.02 for sources in which recoils were stopped in gold, and 0.67 ± 0.01 for sources in which recoils were stopped in aluminum. Unattenuated angular correlations were obtained with liquid sources containing Am^{243} in 0.5M and 1.0M $HClO_4$. For liquid sources containing Am^{243} in 3.0M $HClO_4$, the correlation was attenuated with an average attenuation coefficient of 0.86 ± 0.01. Attenuated angular correlations were also found with liquid sources containing an even-even nuclide in dilute aqueous solutions. The average attenuation coefficients for the even-even nuclide liquid sources were $G_2 = 0.75 \pm 0.05$ and $G_4 = 0.86 \pm 0.03$ for U^{232}, $G_2 = 0.64 \pm 0.06$ and $G_4 = 0.84 \pm 0.04$ for Th^{230}, and $G_2 = 0.76 \pm 0.11$ and $G_4 = 0.90 \pm 0.07$ for Ra^{226}. The postulate that the measured angular correlation function for Am^{243} was attenuated by the same amount as the correlation functions for the even-even nuclides was found to be untenable since it required unreasonable alpha mixing ratios or unreasonable admixtures of M2 to E1 gamma radiation in the Am^{243} decay process. The attenuation observed with even-even nuclide sources was believed to be consistent with the postulate of a time-dependent electric interaction.

28058 LONGITUDINAL POLARIZATION OF BISMUTH^{210} BETA PARTICLES. Alfred Ludvik Vampola (St. Louis Univ.). Dissertation Abstr., 22: 3240(Mar. 1962).

The longitudinal polarization of Bi^{210} β particles was determined as a function of energy using the double Mott-scattering method. Corrections for depolarization effects were made using theoretical calculations and by comparison of results obtained for P^{32} with the same apparatus. Scattering asymmetry was determined for five energy groups within (0.449 to 0.798) v/c. The electron polarization was measured as (0.53 to 0.77) ± 0.06 and (0.59 to 0.66) ± 0.055, in units of v/c, for v/c centered at 0.71 and 0.80 respectively, including corrections for scatterer and source depolarizations. The electron polarization for the three lower energies could not be calculated due to the non-applicability of the formulas. The results were consistent with time-reversal invariance within a phase angle of +3 to 0°.

28059 SCATTERING OF POSITRONS BY SIX FOLD IONIZED URANIUM ATOM. Bhajan Singh (Science Coll., Patna, [India]) and Brojendra K. Guha. Indian J. Phys., 36: 189-92(Apr. 1962). (In English)

The S-wave cross section for the elastic scattering of low velocity positrons by U(VI) is calculated using the modified Coulomb potential. It is found that Coulomb scattering is predominant. (auth)

28060 RESONANCE FORMULA FOR PHOTONUCLEAR REACTIONS. A. V. Bravin (Saratov State Univ., USSR). Izvest. Vysshikh Ucheb. Zavedenii, Fiz., No. 3, 14-20(1962). (In Russian)

A formula was derived for cross sections of nuclear reactions that clearly expresses the resonance as a function of incident quantum energy. The obtained formula may be used in calculating absorption cross sections for γ quanta, probabilities of nuclear emissions, and the complete level widths, considering nucleon interactions are described by two-dimensional forces. (R.V.J.)

28061 WAVELENGTHS, ENERGY LEVELS, AND PRESSURE SHIFTS IN MERCURY 198. Victor Kaufman (National Bureau of Standards, Washington, D. C.). J. Opt. Soc. Am., 52: 866-70(Aug. 1962).

The vacuum wavelengths of 27 lines of Hg^{198} and 6 lines of Kr^{86} were measured relative to the international standard of length, the Kr^{86} line at 6057.80211 Å, by photographic Fabry-Perot interferometry. These measurements were made with Hg^{198} electrodeless lamps containing argon at pressures of ¼, 3, and 10 mm Hg and a Kr^{86} hot-cathode lamp operated according to the conditions prescribed by the International Conference on Weights and Measures in 1960. Energy-level values were derived from the wavelengths of each of the Hg^{198} sources, and on the basis of these values, the energy level and wavelength shifts per unit pressure of argon were calculated. The suitability of the Hg^{198} electrodeless lamp as a source of wavelength standards for interferometric measurement of length and wavelength is discussed. (auth)

28062 VALIDITY OF THE ELECTRICAL MODEL REPRESENTATION OF THE EFFECTS OF NUCLEAR MAGNETIC RESONANCE. Georges Bonnet (Centre d'Études Nucléaires, Grenoble, France). J. phys. radium, 22: 204-14(Apr. 1961). (CEA-2025). (In French)

When studying the behavior of a magnetic resonance transductor formed by the association of an electrical network and of a set of nuclear spins, it is possible to bring about a representation that is analytically equivalent by means of an entirely electrical model, available for transients as well as steady state. A detailed study of the validity conditions justifies its use in most cases. Also proposed is a linearity criterion of Bloch's equations in transient state that is simply the prolongation of the well-known condition of non-saturation in the steady state. (auth)

28063 NEUTRON COUNTING AND DETERMINATION OF BORON BY DETECTION OF γ RAYS IN DE-EXCITATION OF Li^7 NUCLEI PRODUCED BY THE REACTION $B^{10}(n,\alpha)Li^7$. J. Laune (Institut Interuniversitaire des Sciences Nucléaires, Brussels). J. phys. radium, 23: 238-40(Apr. 1962). (In French)

When irradiating B^{10} with slow neutrons, 93% of the Li^7 nuclei formed are left in an excited state. The detection of the de-excitation γ ray may be used for counting neutrons and for the determination of boron. (auth)

28064 MEASUREMENT OF THE CIRCULARLY POLARIZED β-γ ANGULAR CORRELATION IN As^{76}. M. Delabaye, J. P. Deutsch, and P. Lipnik (Université, Louvain, Belg.). J. phys. radium, 23: 257-8(Apr. 1962). (In French)

In the decay of As^{76}, a β radiation with a maximum energy of 2.4 Mev followed by a γ ray of 559 kev occurs. The results of the measurement of the circular polarization of the 559-kev γ radiation in coincidence with the 2.4-Mev β ray are reported. The measurement was made at an angle of 180° between two detectors, and the β rays with energy below 350 kev are excluded by an Al screen. A polarization factor of $\omega = -0.035 \pm 0.049$. The results were corrected for the solid angle and the errors in K and v/c. (J.S.R.)

28065 (d,α) REACTIONS ON F^{19}, Ne^{20}, P^{31}, AND S^{32} AT 14.7 Mev. Kunio Takamatsu (Kyoto Univ.). J. Phys. Soc. Japan, 17: 896-906(June 1962). (In English)

The angular distributions of the emitted alpha particles from the (d,α) reactions on F^{19}, Ne^{20}, P^{31}, and S^{32} leading to the ground and excited states of the residual nuclei were measured at 14.7 Mev. The alpha particles were detected using a solid-state detector of a silicon p-n junction. The alpha particle groups, α_0 of the ground state transitions for all targets and the alpha particle groups of excited state transitions for F^{19} and S^{32} show pronounced peaks at forward angles and oscillatory behaviors in the angular distributions; these were compared, and they agreed with the theory of the two-nucleon pickup process. The angular distributions of other alpha particle groups for excited

state transitions show nearly symmetrical behaviors about 90° and the cross sections of them are smaller by about a factor of 2 to 5 than those of α_0. This suggests that these reactions occur through processes different from the surface direct interaction process and are consistent with the level structures of residual nuclei predicted from the shell model. The mass number dependence of the integrated cross sections for the ground state transitions was obtained. The values of the cross sections are proportional to the inverse cubes of mass number A and the values of the cross sections for even-even nuclei are about 3 times larger than those for odd-odd and odd nuclei, in the mass region $14 \lesssim A \lesssim 32$. (auth)

28044 DECAY OF RADIOISOTOPE Ga^{68}. Soji Kono (Tokyo Univ.). J. Phys. Soc. Japan, 17: 907-14(June 1962). (In English)

The decay of Ga^{68}(68 min) is investigated using beta and gamma scintillation spectrometers. Two beta components having endpoint energies of 1.95 ± 0.03 and 0.88 ± 0.05 Mev are observed. Gamma-rays of 0.80 ± 0.02, 1.08 ± 0.01, 1.24 ± 0.02 and 1.88 ± 0.01 Mev are confirmed. Angular correlations of the 1.08 to 0.80-Mev gamma cascades in Zn^{68} are measured. The Legendre polynomial expansion coefficients are $A_2 = 0.237 \pm 0.056$ and $A_4 = 0.39 \pm 0.062$. The measured correlation establishes the spin sequence to be 2-2-0, with a quadrupole-dipole mixing ratio δ of $-(4^{+3}_{-2})$ for the 0.80 Mev gamma-ray. The results of the angular correlation work with the allowed nature (log ft = 5.7) of the electron capture decay to the 1.88-Mev level assign the spin and parity of this level at 2+. Results are consistent with the systematics given by Sakai for low excited states of even-even nuclei. (auth)

28047 $Al^{27}(d,\alpha)Mg^{25}$ REACTION AT 14.7 Mev. Takuji Yanabu (Kyoto Univ.), Sukeaki Yamashita, Teruo Nakamura, Kunio Takamatsu, Akira Masaike, Shigeru Kakigi, Dai Ca Nguyen, and Kiyohiko Takimoto. J. Phys. Soc. Japan, 17: 914-20(June 1962). (In English)

The angular distributions were measured for the eight groups of alpha particles leading to the ground and excited states of Mg^{25} from the reaction $Al^{27}(d,\alpha)Mg^{25}$ at 14.7 Mev using a semiconductor detector of p-n junction. The differential cross sections of the reactions leading to the single levels of Mg^{25} are compared with a formula obtained from the two-nucleon pick-up theory. The experimental angular distributions for each alpha group with a comparatively large cross section agrees, at least in forward angle, with the theoretical curve. The alpha group leading to the 3.40-Mev level of Mg^{25} comes from the transition to the $^9/_2$+ state, rather than to the $^3/_2$− state. The total cross-sections for the levels of Mg^{25} corresponding to the same K-band $^5/_2$+ as that of the ground state of Al^{27} are larger than the others. (auth)

28048 RADIOCHEMICAL STUDIES ON THE MULTIPLE FISSION OF URANIUM. II. DETERMINATION OF THE FISSION YIELD OF THE $Ni^{66}-Cu^{65}$ CHAIN IN THE THERMAL FISSION OF U^{235}. R. Muenze and O. Hladik (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 5: 472-3(June 1962). (In German)

The Ni activity found by Roy in the products of U fission could be confirmed. The fission yield was determined to be 2×10^{-4}%. (tr-auth)

28049 REMARKS ON THE RADIOCHEMICAL DETERMINATION OF α PARTICLES IN THE FISSION OF URANIUM. R. Muenze (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 5: 488(June 1962). (In German)

In a previous publication on the quantitative evaluation of the $Fe^{54}(\alpha,n)Ni^{57}$ reaction initiated by fission α particles, a value of 1/625 was used for the frequency of fission with α emission. More accurate measurements on individual α reactions with Fe^{56} have become available since that time. By multiplication of the individual pair of values and graphic integration, the function of the most frequent α energy in the single layers was determined. The relationship for the mean effective cross section leads to an effective layer density of 21 cm air equivalent and to an integral cross section of 60 mb. Therefore for the irradiation sample, a formation rate of 4.05×10^3 α particles/sec was obtained. This value together with the number of normal binary fissions (1.23×10^{12}/sec) yields a frequency of 330 ± 66 binary fissions/fission with α emission. (J.S.R.)

28070 SEPARABLE NON-LOCAL INTERACTIONS IN NUCLEI. V. L. Narasimham, S. K. Shah, and S. P. Pandya (Physical Research Lab., Ahmedabad, India). Nuclear Phys., 33: 529-35(June 1962). (In English)

The lowest six even parity states of Li^6 are calculated in the L-S coupling scheme with the use of separable nonlocal potentials proposed by Mitra et al. It is shown that the noncentral terms of the potential give very small contributions to the energies of these states. The reaction matrix evaluated with the central terms of the interaction does give matrix elements in these states that are in good agreement with experiment. (auth)

28071 INELASTIC SCATTERING OF PROTONS FROM Ti^{48}, Cr^{52}, Fe^{56}, Ni^{58}, Ni^{60} AND Zn^{64} AT AN ENERGY OF 14.65 Mev. Kazuhisa Matsuda (Tokyo Univ.). Nuclear Phys., 33: 536-65(June 1962). (In English)

Energy spectra and absolute cross sections on inelastic protons from a number of even nuclei with masses between A = 48 and A = 64 have been obtained. The experiment was performed with a broad range magnetic analyzer. The energies of levels up to 6 Mev, excited appreciably, were determined from 60° spectra and compared with the results obtained by Buechner et al. Energy values of many new levels including "anomalous levels" have been assigned. The absolute differential cross sections and the rough angular distributions for some levels were measured over a range of angles from 15° to 145°. The angular distribution exhibits a forward peak in general and is compared with the prediction of simple theories. The first 2^+ state and the "anomalous" state are excited strongly and their angular distributions are fitted well at their forward peak with a simple Born approximation (SBA) prediction assuming $\Delta l = 2$ and $\Delta l = 3$, respectively. It is elucidated that the anomalous peak in the mass range concerned (even nuclei) is caused only from a single 3^- state. The yields for the first 2^+ and the 3^- states are discussed quantitatively. The excitation of other low lying states including the second 4^+ or 2^+ states have been investigated. The fact that the angular distributions for the first 2^+ and the 3^- states can be fitted with the SBA curves permits an attempt to assign spin parity for some other excited states. The integrated cross sections for these levels are also presented and discussed. (auth)

28072 THE DISTORTED WAVE THEORY OF HEAVY PARTICLE STRIPPING. D. Robson (Univ. of Melbourne). Nuclear Phys., 33: 594-613(June 1962). (In English)

The nuclear reaction known as heavy particle stripping is treated as a general type of nuclear reaction using the distorted wave Born approximation. General expressions for angular distributions and polarizations are obtained and simple cases discussed. The dynamical part of the amplitude is evaluated by the method of Fourier trans-

forms which allows the center-of-mass motion of the "heavy particle" or "core" to be included without any approximations being made. The decay of the residual nucleus by γ radiation following a heavy particle stripping reaction is examined with particular reference to the $B^{11}(d,n)C^{12*}(\gamma)C^{12}$ reaction. A close similarity between heavy particle stripping and compound nucleus theory is found when the center-of-mass motion of the core is neglected. The assumed relationship between heavy particle stripping and backward peaked angular distributions becomes questionable when distorted waves are used. It is concluded that more refined experiments are required to establish the true importance of heavy particle stripping in nuclear reactions. (auth)

28073 THEORETICAL NEUTRON CROSS SECTIONS FOR THE DIRECT EXCITATION OF THE 3⁻ COLLECTIVE STATE IN O^{16} AND Pb^{208}. G. L. Payne and D. R. Snider (Ohio State Univ., Columbus). Nuclear Phys., 33: 626-32 (June 1962). (In English)

The cross sections for the direct excitation of a surface octupole state in two doubly magic nuclei, O^{16} and Pb^{208}, are calculated for neutrons of four different energies. For O^{16} the excitation energy of the surface octupole state is 6.13 Mev and cross sections are calculated for neutrons of 10, 14, 22, and 30 Mev. The excitation energy of the 3⁻ state in Pb^{208} is 2.615 Mev and the cross sections are calculated for neutrons at 4, 7.5, 12, and 18 Mev. The calculations are carried out using the distorted wave Born approximation with the wave solution to a spherical square well potential as the unperturbed wave function. The interaction is assumed to occur in a finite region at the nuclear surface. A complex potential is used to account for neutrons scattered by compound nucleus formation. For both nuclei the results show that direct excitation should be a significant part of the total cross section for exciting these states. (auth)

28074 HIGH-ENERGY GAMMA RAYS FROM Na^{24}. J. E. Monahan, S. Raboy, and C. C. Trail (Argonne National Lab., Ill.). Nuclear Phys., 33: 633-8(June 1962). (In English)

The gamma-ray spectrum from Na^{24} has been studied with a scintillation spectrometer with an anticoincidence annulus of NaI(Tl). Gamma rays with energies of 3.85 Mev and 4.1 Mev are observed in addition to the well known gamma rays with energies of 2.753 Mev and 1.3686 Mev. The intensities of the 3.85 Mev gamma ray and the 4.1 Mev gamma ray relative to the 2.75 Mev gamma ray are measured to be $(7.5 \pm 2) \times 10^{-4}$ and $(8 \pm 3) \times 10^{-5}$, respectively. An upper limit of 7×10^{-6} is placed upon the intensity of a 5.5 Mev gamma ray relative to the 2.75 Mev line. (auth)

28075 A 53 min ISOMER OF CAESIUM 135. Hans Warhanek (Argonne National Lab., Ill.). Nuclear Phys., 33: 639-47(June 1962). (In English)

A new isomer of Cs^{135} is described. Its half life is 53 ± 2 min. The excitation energy is 1.62 Mev, the spin is at least $17/2$. It decays to the ground state by emission of an 840 ± 15 kev γ ray followed by a 780 ± 5 kev γ ray. The K conversion coefficient of the 840 kev transition indicates M4 but E6 cannot be excluded. The Weisskopf single particle estimate for M4 gives a half life 60 times smaller than experimentally observed. (auth)

28076 POLARIZATION EFFECTS IN THE $Li^7(p,\alpha)He^4$ REACTION. K. Bearpark, I. Hall, R. E. Segel, S. M. Shafroth, and N. W. Tanner (Clarendon Lab., Oxford). Nuclear Phys., 33: 648-63(June 1962). (In English)

Polarization effects in the $Li^7(p,\alpha)He^4$ reaction have been sought by initiating the reaction with protons polarized by elastic scattering from carbon. The left-right asymmetries in the resultant alpha particles were measured at lab angles of 52° and 120° which are approximately equivalent because of the requirement that the reaction show mirror symmetry about 90° (c.m.). The data at the two angles were averaged which served to minimize possible spurious asymmetries. Spurious asymmetries were also checked by substituting platinum for carbon as the initial scatterer. Data were taken at 7 energies ranging from 0.30 to 3.19 Mev. Large polarizations were found at all energies. These averaged some 43% at the four highest energies but apparently dropped off at lower energies. The use of the $Li^7(p,\alpha)He^4$ reaction in a proton polarimeter is discussed extensively. It is concluded that such a polarimeter shows considerable promise. (auth)

28077 A MODEL FOR ODD PARITY STATES IN EVEN NUCLEI. J. P. Davidson (Rensselaer Polytechnic Inst., Troy, N. Y.). Nuclear Phys., 33: 664-79(June 1962). (In English)

The level structure of negative parity levels in deformed even nuclei are explained by a collective model in which the nuclear surface in these excited states contains only the spherical harmonics $Y_{3,0}$ and $Y_{3,\pm 2}$, the moments of inertia being expressed in terms of two new variables ζ and η, the octupole deformation and asymmetry parameters, respectively. The energy eigenvalues for the rotation of such a rigid, asymmetric octupole surface are obtained. A ζ-like vibration is then added in a manner analogous to β-vibrations in the quadrupole case. Electromagnetic transitions are discussed and branching ratios for E2 and E3 transitions are given. The model is compared with experiment for those even nuclei which have at least three negative parity levels in one ζ-vibrational band and it is found to account for the observations quite well for large A. (auth)

28078 ELASTIC AND INELASTIC SCATTERING OF 14 Mev NEUTRONS FROM THE LITHIUM ISOTOPES. Calvin Wong, John D. Anderson, and John W. McClure (Univ. of California, Livermore). Nuclear Phys., 33: 680-4(June 1962). (In English)

The angular distributions of elastically scattered 14-Mev neutrons have been measured for Li^6, Li^7, and natural Li from 20° to 130°. Inelastic scattering to the 2.18 Mev level in Li^6 and the 4.6 Mev level in Li^7 has been measured over a more restricted angular range. In Li^6 the 3.57 Mev level is not excited appreciably. The inelastic neutrons from the 2.18 Mev level in Li^6 and the 4.6 Mev level in Li^7 are peaked in the forward direction, which is indicative of a direct reaction. (auth)

28079 NOTE ON THE TWO-NUCLEON STRIPPING REACTION. Shiro Yoshida (Univ. of Pittsburgh). Nuclear Phys., 33: 685-92(June 1962). (In English)

The magnitude of the two-nucleon stripping reactions is calculated using the pairing interaction model. The calculation also is applied to final states of collective type. For some types of reaction a collective enhancement of the reaction cross section is predicted. (auth)

28080 Be^{11}: A SHELL MODEL ANOMALY. D. J. Pullen (Clarendon Lab., Oxford), A. E. Litherland, S. Hinds, and R. Middleton. Nuclear Phys., 36: 1-15(July 1962). (In English)

The Be^{11} nucleus has been studied using the $Be^9(t,p)Be^{11}$ reaction at 6 and 10 Mev triton energy. The Q value for the reaction was observed to be −1.164 ± 0.015 Mev which corresponds to an energy difference between B^{11} and Be^{11} of 11.510 ± 0.015 Mev. At 10 Mev triton energy 6 energy levels of Be^{11} were observed. These were at 0.319 ± 0.010 Mev, 1.780 ± 0.025 Mev, 2.700 ± 0.025 Mev, 3.410 ± 0.025

Mev, 3.590 ± 0.020 Mev, and 3.960 ± 0.020 Mev. The natural widths have also been measured for some of these states. Angular distributions of the protons from the reactions $Be^9(t,p)Be^{11}$ and $O^{16}(t,p)O^{18}$ were measured at 6 and 10 Mev in the first case of 10 Mev in the second case. The $O^{16}(t,p)O^{18}$ angular distributions agreed well with double stripping theory and in contrast the $Be^9(t,p)Be^{11}$ angular distributions were not interpretable. Angular distributions from the $C^{12}(t,\alpha)B^{11}$ reaction at 10 Mev triton energy were also studied in an attempt to obtain information on the spins and parities of some of the states in B^{11} which are involved in the beta-decay of Be^{11}. A comparison of the experimental results with the theoretical predictions on B^{11} by Talmi and Unna is included. (auth)

28081 VELOCITY DEPENDENT NUCLEAR FORCES AND THE REPULSIVE CORE AS THE POSSIBLE CONSEQUENCE OF CLASSICAL RELATIVISTIC EFFECTS. Anatole B. Volkov (Technion-Israel Inst. of Tech., Haifa). Nuclear Phys., 36: 16-30(July 1962). (In English)

The classical relativistic equation of motion for two nucleons interacting via a scalar action-at-a distance potential is obtained in a manner similar to the classical electromagnetic "adjunct" field method of Wheeler and Feynman. The relativistic equation of motion is transformed into a Newtonian equation with an effective potential which includes all relativistic effects. An investigation of the motion of the particles in the region of the potential singularity shows that the repulsive core, found by other investigators for a special case, does not exist in the more realistic case. It is found that the potential singularity is removed by relativistic effects and the effective potential has a relatively small velocity dependence even up to 400 Mev laboratory scattering energy. The effect of this velocity dependence on the scattering phase shift for $^1S_0$ scattering is investigated phenomenologically. (auth)

28082 THE INTERNAL DECAYS OF Pb^{197m} AND Pb^{199m}. B. Jung, G. Andersson, and T. Stenstroem (Univ. of Uppsala). Nuclear Phys., 36: 31-7(July 1962). (In English)

Evidence is presented for the existence of an 84.9 ± 0.2 kev M1 transition in cascade with the earlier known 234 kev M4 transition from 42 min Pb^{197m}. The upper energy limit for an analogous gamma ray following the 424 kev M4 transition in Pb^{199} was lowered to 9.3 kev. The indicated relative movements of the levels are in basic agreement with pairing force calculations. (auth)

28083 THE ABSOLUTE CROSS SECTIONS FOR THE $Na^{23}(n,\alpha)$ AND $I^{127}(n,\alpha)$ REACTIONS AT 14 Mev. P. G. Bizzeti, A. M. Bizzeti-Sona, and M. Bocciolini (Università, Florence and Istituto Nazionale di Fisica Nucleare, Florence). Nuclear Phys., 36: 38-44(July 1962). (In English)

The absolute cross sections for the $Na^{23}(n,\alpha)F^{20}$ and $I^{127}(n,\alpha)Sb^{124}$ reactions are measured at 14 Mev neutron energy. The α particles produced in a NaI crystal were directly counted by a pulse shape discrimination method. The neutron flux was measured with a standard proton recoil monitor. The cross sections values obtained are 169 ± 18 mb for the $Na^{23}(n,\alpha)F^{20}$ reaction and 1.39 ± 0.17 mb for the $I^{127}(n,\alpha)Sb^{124}$ reaction. (auth)

28084 THE BETA DECAY OF B^{13}. A. Marques, A. J. P. L. Policarpo, and W. R. Phillips (Univ. of Manchester, Eng.). Nuclear Phys., 36: 45-55(July 1962). (In English)

The nucleus B^{13} was made in the reaction $B^{11}(t,p)B^{13}$ and its radiations were studied with plastic and NaI(Tl) scintillation spectrometers both singly and in coincidence. The half life was determined as 18.6 ± 0.5 msec. Decay takes place by beta-ray emission to the C^{13} ground state (93%, log ft = 4.01) and to the 3.38 Mev excited state (7%, log ft = 4.53). Limits are set on the decay to other levels in C^{13}. It is concluded that the ground state has spin and parity $^3/_2-$ as expected. No evidence was found for a beta branch to a possible $^5/_2-$ level in C^{13} which is predicted by the independent particle model. (auth)

28085 QUASI-DEUTERON PRODUCTION BY HIGH-ENERGY DIPOLE γ-RAYS IN ^{16}O. Arne Reitan (NORDITA, Copenhagen). Nuclear Phys., 36: 56-70(July 1962). (In English)

The total cross section for direct absorption of high-energy photons by neutron-proton pairs is evaluated, in the dipole approximation, for oxygen, on the assumption of shell-model initial-state wave functions. Besides, the corresponding integrated cross section is considered. The results are compared with those obtained from the Lavinger quasi-deuteron model. (auth)

28086 STATES IN B^{10} FROM ELASTIC SCATTERING OF ALPHAS BY Li^6. G. Dearnaley, D. S. Gemmell, and S. S. Hanna (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 36: 71-81(July 1962). (In English)

The elastic scattering of alpha particles from Li^6 was observed from E_α = 0.9 to 2.7 Mev corresponding to excitation energies in B^{10} of 5.1 to 6.2 Mev. Resonance structure was obtained for the 5.92 Mev level and for the 5.18 Mev level, recently discovered by Sprenkel et al. The analysis gives assignments of $2^+(l_\alpha = 2)$ and $1^+(l_\alpha = 0)$, respectively, for these levels. In each case, two-nucleon excitation from the p-shell may be involved. In particular, the assignment of 1^+ and T = 0 to the 5.18 Mev level supports the proposal made by True and Warburton that this level is a member of the doublet formed by two-nucleon excitation into the 2s shell, the other member being the 0^+, T = 1 level at 756 Mev. (auth)

28087 THE DECAY OF 62 min Sn^{128} AND 10.8 min Sb^{128}. P. Del Marmol and J. Colard (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Nuclear Phys., 36: 109-18(July 1962). (In English)

The decay of 62 min Sn^{128} separated from products of U^{235} thermal neutron fission and of its daughter 10.8 min Sb^{128} was studied by γ and β-ray spectrometry and by γ-γ and β-γ coincidence measurements. The 62 min Sn^{128} decay shows γ rays at 44 ± 1, 72 ± 2, 497 ± 6, and 570 ± 10 kev and β rays at ≈0.70 and 0.80 Mev. The 10.8 min Sb^{128} decay shows γ rays at 320 ± 3 kev, 754 ± 10 kev (2γ-rays), and 1070 ± 20 kev in coincidence with a β ray at 2.45 Mev. Other β-transitions deduced from γ-ray intensities are discussed, and a decay scheme is proposed. Gamma rays of adjacent Sn and Sb isotopes are presented but have not been further investigated. (auth)

28088 BACK ANGLE PEAKING AND EXCHANGE EFFECTS IN (d,p) AND (d,n) REACTIONS. F. S. Levin (Rice Univ., Houston, Tex.). Nuclear Phys., 36: 119-40(July 1962). (In English)

The exchange amplitude occurring in a description of (d,p) and (d,n) reactions is evaluated using the distorted wave approximation. By employing assumptions similar to those of the corresponding non-exchange (DWBA) calculation, only a distorted wave knock out amplitude is found to be important. The distorted wave analog of the plane wave heavy particle stripping amplitude does not occur. It is thus concluded that the proper explanation for back angle peaking in (d,p) and (d,n) reactions is to be found in the focusing effects of the optical model. A simple model

of the knock out process is used to estimate the magnitude and shape of the exchange amplitude in the surface approximation. The magnitude is found to be strongly dependent on the structure of the initial and final states and can be large in some cases. Hence, the exchange term may provide the enhancement needed to secure better agreement between distorted wave calculations and experiment. (auth)

28089 PHOTODISINTEGRATION OF CALCIUM. Sven A. E. Johansson and Bengt Forkman (Univ. of Lund, Sweden). Nuclear Phys., 36: 141-50(July 1962). (In English)

Photoproton spectra of calcium were recorded at bremsstrahlung maximum energies of 19.5 and 20.5 Mev. By subtraction a proton spectrum corresponding to photon absorption in the range 20 ± 0.5 Mev was obtained. The proton spectra show well resolved peaks corresponding to transitions to the ground state and excited states at 2.9 Mev and 5.9 Mev. These states are assumed to be the single particle hole states in K^{39} with spin values $d_{3/2}$, $s_{1/2}$, and $d_{5/2}$. These assignments are supported by a comparison of experimental branching ratios and angular distributions with theoretical values calculated on the basis of the results of Brown et al. (auth)

28090 CONFIGURATION MIXING IN THE MASS 14 SYSTEM. Hans A. Weidenmueller (California Inst. of Tech., Pasadena). Nuclear Phys., 36: 151-60(July 1962). (In English)

It is shown that a Hamiltonian consisting of central, spin-orbit, and tensor forces cannot give the properties of the low-lying positive parity states in the mass 14 system if only p-shell states are considered, and if the central and spin-orbit matrix elements are chosen in accord with the values found in fitting the properties of neighboring nuclei. It is suggested that configuration mixing plays an important role even for the low-lying states of this system. (auth)

28091 ENERGY LEVELS IN Si^{27}, Co^{56} AND Zn^{63}. J. D. Anderson, C. Wong, and J. McClure (Univ. of California, Livermore). Nuclear Phys., 36: 161-8(July 1962). (UCRL-6756). (In English)

The neutron spectra from the (p,n) reaction on Al, Fe^{56}, and Cu^{63} were measured at a laboratory angle of 23° to determine the energy levels of the residual nuclei. The protons were obtained from the Livermore variable energy cyclotron. The neutron energies were measured using time-of-flight techniques and a long (9 to 15 meter) flight path. In Si^{27} eighteen levels were resolved. The agreement with the nine levels up to an excitation of 4.13 Mev previously reported from charged particle work is excellent. The additional levels are 4.29, 4.45, 4.70, 5.00, 5.08, 5.21, 5.30, 5.38, and 5.51 Mev with an error of ±0.04 Mev. Neutron groups were observed corresponding to the following excitations in Co^{56}: 0.165, 0.560, 0.825, 0.980, and 1.105 Mev with an error of ±0.015 Mev. In Zn^{63} the following levels were excited: 0.214, 0.640, 1.047, 1.246, 1.386, 1.640, and 1.697 Mev with an error of ±0.025 Mev. (auth)

28092 LOW MOMENTUM TRANSFER REACTIONS IN COMPLEX NUCLEI AT HIGH ENERGY. Torleif Ericson, Franco Selleri, and Remy T. Van de Walle (CERN, Geneva). Nuclear Phys., 36: 353-67(Aug. 1962). (In English)

The radiochemical cross sections for simple spallation reactions at very high energy are calculated from the elementary nucleon-nucleon and pion-nucleon interactions using the impulse approximation and are expressed in terms of nuclear form factors. Elimination of the nuclear form factors by comparison of pion and proton induced reactions may give information on the ($\pi\pi$) interaction. (auth)

28093 THE NUCLEON-NUCLEUS SECOND-ORDER OPTICAL POTENTIAL. Robert R. Johnston (Los Alamos Scientific Lab., N. Mex.). Nuclear Phys., 36: 368-85(Aug. 1962). (In English)

The optical model potential for the scattering of high-energy nucleons by nuclei is evaluated in terms of nucleon pair correlations in nuclei, using phase shifts from nucleon-nucleon scattering to give the relevant scattering amplitudes. Some effects due to the nonlocal nature of the potential are discussed. (auth)

28094 STUDY OF THE CADMIUM ISOTOPES (III). BETA- AND GAMMA-RAY SPECTROSCOPY OF In^{109}. Toshio Katoh (Osaka Univ.), Masao Nozawa, Yasukazu Yoshizawa, and Yujiro Koh. Nuclear Phys., 36: 394-410 (Aug. 1962). (In English)

The decays of 58 min and 40 min In^{109} have been studied in order to investigate the excited states of Cd^{109}. Spectra of beta rays, internal conversion electrons, and gamma rays were obtained using a sector-type beta-ray spectrometer and scintillation spectrometers. Many new gamma rays were found and the maximum energies of the beta rays were determined to be 3.50 ± 0.05 Mev for the 40 min isomer and 1.29 ± 0.08 Mev for the 58 min isomer. The decay scheme of In^{109} was established with the aid of about 20 gamma rays. The 40 min 2 + state of In^{109} was determined to be about 40 kev higher than the 58 min high spin state, and the 2+ second excited state of 1.475 Mev in Cd^{109} was found. The ratios of the reduced transition probabilities of the gamma rays and the log ft values were discussed. (auth)

28095 STUDY OF THE CADMIUM ISOTOPES (IV). BETA- AND GAMMA-RAY SPECTROSCOPY OF In^{109}. Masao Nozawa (Osaka Univ.). Nuclear Phys., 36: 411-30(Aug. 1962). (In English)

Beta and gamma rays in the decay of In^{109}(4.3 h) were investigated using a two-directional focusing beta-ray spectrometer and scintillation spectrometers. The maximum energy of the positron spectrum was determined to be 0.790 ± 0.008 Mev, and many new gamma rays of considerable intensity were found, having energies of 0.326, 0.340, 0.623, 0.627, 0.651, 0.725, 0.821, 1.047, 1.148, 1.194, 1.545, 1.614, and 1.680 Mev. On the basis of the measurements of internal conversion electrons, gamma-ray single, summing peak, beta-gamma, and gamma-gamma coincidence spectra, a new decay scheme for In^{109} is proposed. The spins and parities of the levels of Cd^{109} are discussed in relation to the level schemes of the neighboring odd-mass cadmium isotopes. (auth)

28096 STUDY OF THE CADMIUM ISOTOPES (V). BETA- AND GAMMA-RAY SPECTROSCOPY OF In^{113}. Jian-Zhi Ruan (Osaka Univ.), Yasukazu Yoshizawa, and Yujiro Koh. Nuclear Phys., 36: 431-40(Aug. 1962). (In English)

The decay of In^{113} (21 min and 12 min) was investigated. The beta-ray and internal conversion spectra were measured by using a beta-ray spectrometer. The maximum energies of positrons and electrons are 1.56 ± 0.02 Mev (21%) and 0.670 ± 0.015 Mev (44%), respectively; gamma transition energies are 0.157 ± 0.002 Mev and 0.621 ± 0.01 Mev. Weak gamma rays were searched for by means of a scintillation spectrometer; weak gamma rays of 0.85 Mev (0.4%), 1.24 Mev (0.5%), and 1.48 Mev (0.3%) were found. The decay scheme was then constructed. The K-shell conversion coefficient and K/L ratio for the 0.157 Mev isomeric transition were determined as 3.3 ± 0.7 and 5.8 ± 1.2, respectively. The K-shell conversion coefficient of the 0.621 Mev gamma transition was also obtained as $(3.8 \pm 0.7) \times 10^{-3}$. Therefore, the isomeric and the 0.62

Mev transitions are assigned as M3 and E2 or M1, respectively. (auth)

28077 THE ELECTRON CAPTURE DECAY OF Gd^{149}. H. J. Prask, J. J. Reidy, E. G. Funk, Jr., and J. W. Mihelich (Univ. of Notre Dame, Ind.). Nuclear Phys., 36: 441-51 (Aug. 1962). (In English)

The electron-capture decay of Gd^{149} has been studied with an intermediate-image β-ray spectrometer, scintillation spectrometers, prompt and delayed coincidence techniques, and directional correlation measurements. The previously reported 650 and 937 kev transitions were found to be composite 646 and 660 kev, and 933 and 940 kev transitions. The assignment of 750 and 790 kev transitions to this activity was confirmed. Energy levels in Eu^{149} are proposed at 0 kev ($5/2^+$), 150 kev ($7/2^+$), 423 kev, 497 kev ($9/2^-$, $T_{1/2}$ = 2.42 μs), 750 kev ($5/2$, $7/2^-$), 796 kev ($9/2$), 940 kev ($5/2$, $7/2$, $9/2$), 958 kev, and 1083 kev. A gamma-gamma directional correlation on the (347 kev) – (150 kev) cascade is consistent with the possibility of mixed multipolarity for either or both of the transitions. (auth)

28078 EFFECTS OF NUCLEAR POLARIZABILITY ON ISOTOPE AND ISOMER SHIFTS. A. S. Reiner and L. Wilets (Weizmann Inst. of Science, Rehovoth, Israel). Nuclear Phys., 36: 457-63(Aug. 1962). (In English)

A comparison of experimental isotope shifts around neutron number 90 with theoretical predictions using accurate values of nuclear parameters shows discrepancies of the order of one standard volume shift. Nuclear quadrupole polarization by the valence electron is calculated and found to account for only a fraction of the existing discrepancy. The greater part of this anomaly and that of even-odd staggering remains as yet unexplained. (auth)

28079 THE (n,d) REACTION ON Fe^{54}. G. Bassani, L. Colli, E. Gadioli, and I. Iori (Università, Milan and CISE, Milan). Nuclear Phys., 36: 471-5(Aug. 1962). (In English)

The angular distribution of deuterons from the pick-up reaction Fe^{54}(n,d)Mn^{53} taken at incident neutron energy of 14 Mev is presented; only high-energy deuterons have been considered. These deuterons correspond to two levels of the residual nucleus Mn^{53}, that is the ground state and the first excited level at 0.39 Mev, which cannot be separated. The results can be interpreted by means of Butcher's calculation using distorted wave Born approximation, attributing a part of the transition to a pick-up reaction with transferred angular momentum l = 1. This shows that the first excited level of Mn^{53} must have spin $1/2$. (auth)

28080 STUDY OF ENERGY LEVELS OF IRON ISOTOPES BY INELASTIC SCATTERING OF ELECTRONS AT 150 Mev. J. Bellicard and P. Barreau (Centre d'Etudes Nucléaires, Saclay, France). Nuclear Phys., 36: 476-96 (Aug. 1962). (In French)

The inelastic scattering of 150-Mev electrons from two even iron isotopes was observed. Six levels were found in Fe^{56} (1.4, 2.9, 4.1, 4.85, 6.4, and 7.2 Mev) and five levels in Fe^{54} (0.85, 2.7, 3.1, 4.45, and 5.05 Mev). By means of a Born approximation analysis of the scattered electron angular distributions the multipolarity was determined, and, by extrapolation, the reduced transition probabilities of corresponding γ transitions. These results establish the collective character of the observed transitions. Electric transitions with L = 2, 3, 4 were identified. For a given multipolarity similar form factors were found. A first group includes the known two first E2 transitions. For each nucleus two octupole vibration levels were found: 4.85 and 6.4 Mev levels for Fe^{54} and 3.1 and 4.45 Mev levels for Fe^{56}. The values of vibration parameters B_L and C_L connected with the collective model confirm the collective character of levels excited by inelastic electron scattering. (auth)

28101 MEASUREMENT OF THE L/K AND M/L CAPTURE RATIOS IN ^{71}Ge DECAY. C. Manduchi and G. Zannoni (Università, Padua and Istituto Nazionale di Fisica Nucleare, Sezione, Padua). Nuclear Phys., 36: 497-504(Aug. 1962). (In English)

A direct measurement of the L/K and M/L capture ratios of Ge^{71} has been made using a multiwire proportional counter. The L/K capture ratio was found to be 0.1187 ± 0.0008, and the M/L capture ratio has been determined to be 0.141 ± 0.010. In addition, a value of 0.106 ± 0.003 was obtained for the L/K capture ratio of Fe^{55}. (auth)

28102 ANALYTIC PROPERTIES OF DIRECT INTERACTIONS. Howard J. Schnitzer (Brandeis Univ., Waltham, Mass.). Nuclear Phys., 36: 505-10(Aug. 1962). (In English)

The singularities nearest to the physical region in the complex cos θ plane (for fixed total energy) are located for stripping reactions using heuristic methods. These analytic properties make it plausible to expect: (1) the exchange stripping contribution not to produce large backward peaks in direct interactions; (2) the Butler pole not to be completely dominant even when it is close to the physical region, because of the nearness of important branch cuts; (3) a properly defined reduced width to be energy independent, in analogy with coupling constants; (4) a characteristic radius to come from form factors (near-by branch cuts) associated with the nucleon-nucleus vertex function; and (5) "simple" pology techniques to be inadequate because of near-by branch cuts due to distortions and Coulomb effects. (auth)

28103 TOTAL PROTON REACTION CROSS SECTION OF COPPER AT 9 Mev. Richard F. Carlson, Robert M. Eisberg, Richard H. Stokes, and Thomas H. Short (Univ. of Minnesota, Minneapolis). Nuclear Phys., 36: 511-16 (Aug. 1962). (In English)

A beam attenuation technique has been used to measure the reaction cross section of copper at an average proton energy of 9 Mev. The result, 895 ± 80 mb, is compared with other measurements. (auth)

28104 MULTIPLE SCATTERING CORRECTIONS TO THE OPTICAL POTENTIAL. James E. Young (Univ. of Copenhagen). Nuclear Phys., 36: 517-26(Aug. 1962). (In English)

A development is given of the self-consistent corrections to the nucleon optical potential. These corrections are implied by and contained in the third-order cluster terms of Brueckner theory as it applies to nucleon-nucleus interactions. The analysis is restricted to nucleons at low bombarding energies where multiple scattering corrections to the nucleon motion are important. It is possible to identify these corrections as the coupling of the neucleon to certain collective nuclear motions. The latter are produced when the cluster sum-over-states is performed according to a given set of prescriptions. (auth)

28105 MEASUREMENT OF THE ABSORPTION CROSS SECTION OF GOLD FOR THERMAL NEUTRONS. H. Teutsch, N. Mateescu, and P. Timis (Inst. for Atomic Physics, Bucharest). Nukleonik, 4: 165-7(June 1962). (In German)

The total effective cross section of gold in the region of cold neutrons from 5.7 to 8.8Å was measured by time-of-flight spectrometry. After correction for scattering and resonance absorption, the rise of the 1/v absorption line

was determined to be 54.47 ± 0.10 barns. By extrapolation, an absorption cross section of gold for thermal neutrons (2200 m/sec) of 98.9 ± 0.3 barns was obtained by consideration of the resonance at 4906 ev and of all measurement inaccuracies occurring. (tr-auth)

28106 THE DECAY OF ^{147}Eu AND ^{148}Eu. S. Jha, R. K. Gupta, H. G. Devare, and G. C. Pramila (Tata Inst. of Fundamental Research, Bombay). Nuovo cimento (10), 25: 28-40(July 1, 1962). (In English)

The spectrum of the γ rays emitted in the decay of Eu^{147} and Eu^{148} was investigated using a scintillation spectrometer. Using the single crystal summing and the coincidence techniques, the positions and the modes of de-excitation of the levels in Sm^{147} and Sm^{148} were established. Decay schemes for Eu^{147} and Eu^{148} were proposed. (auth)

28107 ^{39}K-ISOMERIC STATE FORMATION BY (γ,n) REACTION. D. Goldman, A. F. T. Piza, and E. Silva (Universidade, São Paulo, Brazil). Nuovo cimento (10), 25: 41-7(July 1, 1962). (In English)

Photoneutron cross sections for the ground and isomeric state formation of K^{39} were measured. The experimental branching ratio was compared with statistical theory. It was found that $\sigma = 2$ for the distribution parameter of the density level formula fits the experimental results. A tentative to observation of γ decay of the isomeric to the ground state of K^{39} was performed. (auth)

28108 THE ABSENCE OF CIRCULAR DICHROISM IN $^{16}O_2$ AND A RESULTANT UPPER LIMIT FOR PARITY NONCONSERVATION. L. C. Bradley, III (Massachusetts Inst. of Tech., Cambridge) and N. S. Wall. Nuovo cimento (10), 25: 48-54(July 1, 1962). (In English)

To determine the preferential absorption of one component of a circularly polarized light in a molecular magnetic dipole transition in O_2^{16}, an upper limit to the parity impurity of the states involved in the transition was found. The amplitude of the parity nonconserving part of the states is less than or equal to 3×10^{-6} from a measurement of the circular polarization that is less than or equal to 6×10^{-4}. (auth)

28109 ON THE MECHANISM OF FAST DEUTERON PRODUCTION IN PROTON-NUCLEUS COLLISIONS. E. Balea, E. M. Friedlaender, C. Potoceanu, and M. Sahini (Inst. of Atomic Physics, Bucharest). Nuovo cimento (10), 25: 214-17(July 1, 1962). (In English)

Mechanisms by which deuterons, tritons, and He^3 nuclei at and above 1 Bev are emitted in p-nucleus reactions at and above 10^{10} ev are examined. Results indicate that the evaporation mechanism cannot be responsible for production of fast heavy-hydrogen nuclei. Data are presented in graphical and tabular forms. (L.N.N.)

28110 INTERNAL BREMSSTRAHLUNG FROM ^{89}Sr. S. Belletti, C. Manduchi, G. Nardelli, and M. T. Russo-Manduchi (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padova). Nuovo cimento (10), 25: 254-64(July 16, 1962). (In English)

The internal bremsstrahlung from Sr^{89} is measured by a coincidence arrangement, in which the photons are detected in a NaI(Tl) scintillation crystal and the corresponding β rays by two plastic scintillators, and in which two angles of emission, 45 and 70°, are defined between the β particles and the internal bremsstrahlung. It is possible to test the theoretically predicted differential probability for internal bremsstrahlung emission. The experimental result fits the theoretical expectations. (auth)

28111 ON THE SIZE AND BINDING ENERGY OF THE HELIUM NUCLEUS. S. N. Mukherjee (Banaras Hindu Univ., Varanasi, India). Nuovo cimento (10), 25: 509-12(Aug. 1, 1962). (In English)

The Irving wave function is modified to fit the size and the binding energy of the He^4 nucleus. The wave function naturally reproduces the electric dipole bremsstrahlung-weighted cross section. (auth)

28112 ^{232}Th AND ^{238}U FISSION INDUCED BY LOW-ENERGY MONOCHROMATIC γ-RAYS. H. G. de Carvalho (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome), A. Manfredini, M. Muchnik, M. Severi, H. Boesch, J. Lang, R. Mueller, and W. Woelfli. Nuovo cimento (10), 25: 534-41(Aug. 1, 1962). (In English)

The photofission cross sections of Th^{232} and U^{238} are measured with nuclear emulsions at 6.61 Mev. Good statistics are obtained by combining a monochromatic γ source with certain techniques for loading and processing nuclear emulsions. (auth)

28113 INELASTIC SCATTERING OF PROTON BY He^4. Y. Sakamoto (Kyoto Univ.). Nuovo cimento (10), 25: 565-71 (Aug. 1, 1962). (In English)

The inelastic scattering of 180-Mev protons from the level at about 22 Mev in He^4 is calculated by assuming the He^4 excited level to have $J = 2^-$ and $T = 0$. The calculated results are compared with the experimental data, in order to determine the existence of the level with $J = 2^-$ and $T = 0$ at 22 Mev. The polarizations calculated from Gammel-Thaler and Signell-Marshak phase shifts show negative values, while the experimental data are positive and close to the free proton-nucleon scattering data. (auth)

28114 THE HIGHER RANDOM PHASE APPROXIMATION AND THE STABILITY OF THE ENERGY SPECTRUM OF THE NUCLEAR SHELL MODEL. G. Fano and J. Sawicki (Università, Bologna). Nuovo cimento (10), 25: 586-602(Aug. 1, 1962). (In English)

Assuming only two-body nuclear forces, a study is made of the dynamical two- and many-nucleon correlations in spherical nuclei, using the method of the Heisenberg equations of motion of the one-nucleon operators. After self-consistently solving the Hartree-Fock problem for the shell model, the effect of the remaining nonlinear coupling terms are studied using the method of the higher random phase approximation. In particular, the secular problem is formulated and solved in the second random phase approximation (SRPA) for spherical nuclei. Numerical calculations are carried out for the example of the O^{16} nucleus. The Hartree-Fock shell model spectrum is found to be rather stable against the inclusion of the "triple" correlations. The density fluctuation terms are shown to be rather small but generally capable of introducing a certain damping of some of the single-particle states, as a consequence of the non-hermiticity of the extended SRPA secular matrix. (auth)

28115 PRODUCTION OF ^{3}H IN THE ABSORPTION OF π^- IN ^{4}He. M. V. Bortolani, L. Lendinara, and L. Monari (Università, Bologna and Istituto di Fisica Nucleare, Bologna). Nuovo cimento (10), 25: 603-10(Aug. 1, 1962). (In English)

Experimental results are given on the absorption of π^- mesons in He^4. Using a model in which pions are absorbed on two nucleons, the results of this experiment indicate that absorption takes place essentially on a proton-neutron pair. (auth)

28116 SPURIOUS STATES IN CALCULATIONS OF COLLECTIVE EXCITATIONS IN NUCLEI. Gordon Baym (University of Copenhagen). Phys. Letters, 1: 241-6 (July 1, 1962). (In English)

Starting with the shell-model or Hartree-Fock descrip-

tion of single-particle states, which is localized and violates translational and possibly rotational invariance, a ground state, containing correlations from particle-hole fluctuations and corresponding excited states, is constructed. Infinitesimal translation of this correlated ground state yields a state distinct from the ground state. The difference between the ground state, $|0\rangle$, and its infinitesimally-translated counterpart, $(1 + i\vec{\alpha}\cdot\vec{P})|0\rangle$, is proportional to $\vec{P}|0\rangle$, the total momentum operator acting on the correlated ground state; it is the spurious state. When rotational invariance is violated, the total momentum operator acting on $|0\rangle$ is also a spurious state. Physically, translating or rotating the nucleus in space by a certain amount should not change its energy; spurious states should have zero energy with respect to the ground state. (L.N.N.)

28117 ON QUASI-FREE SCATTERING OF PROTONS BY THE P-PROTON OF Li^6. Yoshiyuki Sakamoto (University of Uppsala). Phys. Letters, 1: 256-7(July 1, 1962). (In English)

Results of calculations on angular correlations in quasi-free proton scattering by the p-proton of Li^6 are presented. Absolute values agree with measured cross sections. Differences between absolute values of the peaks are caused mainly by absorption of the incident and scattered proton waves. (L.N.N.)

28118 A DISTORTED WAVE ANALYSIS OF QUASI-FREE PROTON-PROTON SCATTERING IN Li^6 AND Li^7. T. Berggren (NORDITA, Copenhagen) and G. Jacob. Phys. Letters, 1: 258-61(July 1, 1962). (In English)

Distorted-wave calculations for Li^6 and Li^7 are compared with data. The impulse approximation was used, and the distortion was considered in the semi-classical approximation. Only the coplanar symmetric case was examined; the outgoing protons have equal energies, are in the same plane as the oncoming beam, and form equal angles with it. Discrepancies were obtained; possible explanations are offered. (L.N.N.)

28119 ENERGY LEVELS OF O^{19}. S. K. Shah (Physical Research Lab., Ahmedabad, India). Phys. Letters, 1: 261-2(July 1, 1962). (In English)

Parameters for even- and odd-state interactions are applied to calculate the O^{19} energy-level spectrum. Additional data can aid in distinguishing between the different sets of parameters. (L.N.N.)

28120 NEW EVIDENCE FOR CORE EXCITATION IN Au^{197}. A. Braunstein and A. De-Shalit (The Weizmann Inst. of Science, Rehovoth, Israel). Phys. Letters, 1: 264-6 (July 1, 1962). (In English)

Observations on Au^{197} nuclear spectra are discussed. A level having $J = 3/2^+$ and one having $J = 7/2^+$ in Au^{197}, absent in Tl^{197}, and a small value of $\mu(1/2^+)$ in Au^{197} as compared with $\mu(1/2^+)$ in Tl^{203} and Tl^{205} were observed. A core-excitation model explains these results. The 79th proton goes into the $d_{3/2}$ orbit, and the 81st, into the $s_{1/2}$ orbit. The lowest positive parity excited states result from coupling this odd nucleon to the 2^+ state of the core; this leads to the quadruplet $1/2^+$, $3/2^+$, $5/2^+$, and $7/2^+$ for 79 protons and to the doublet $3/2^+$ and $7/2^+$ for 81 protons. (L.N.N.)

28121 EXCITED STATES IN O^{16}. G. Dearnaley, D. S. Gemmell, B. W. Hooton, and G. A. Jones (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Letters, 1: 269-71(July 1, 1962). (In English)

Gaseous nitrogen, enriched to 95% in N^{15}, was enclosed in a small duralumin chamber into which a beam of protons, collimated to a 16-in. diameter, could be directed through entrance and exit foils of thin nickel. Center-of-mass differential scattering cross sections were measured at 70.1 to 140.8° as a function of proton energy at the target center. Accuracy of the absolute cross-section values was ±10% for the most backward angle, decreasing to ±5% for the forward angle. The uncertainty arose principally from small-angle scattering in glass and foils at lower energies. Since the gas contains 5% of N^{14}, some small resonances may be due to strong variations in the $N^{14}(p,p)$ cross section. (L.N.N.)

28122 THE 5.18 Mev STATE IN B^{10}. B. H. Armitage (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Letters, 1: 284-5(July 1, 1962). (In English)

A 60 $\mu g/cm^2$ boron target enriched in B^{10} was bombarded using 10.44-Mev deuterons, and the inelastically-scattered deuterons were detected at 60°. A region of the B^{10} momentum spectrum, recorded on a nuclear emulsion plate, is illustrated. Energy-level properties were determined; the 2.40-Mev gamma from the 7.56-Mev level populates the 5.18-Mev level. (L.N.N.)

28123 SEARCH FOR THE ANOMALOUS BETA-GAMMA DIRECTIONAL CORRELATION IN Au^{198}. B.-G. Pettersson, W. L. Croft, and J. H. Hamilton (Vanderbilt Univ., Nashville). Phys. Letters, 1: 285-6(July 1, 1962). (In English)

A magnetic lens spectrometer was used to study the β-γ directional correlation in Au^{198}. Two sources were used; results are presented in tabular form. Data contradict previous data (El-Nesr, et al., Z. für Physik, 166: 119 (1962)). (L.N.N.)

28124 ALPHA PARTICLE EMISSION COMPETING WITH THERMAL NEUTRON CAPTURE GAMMA-RAYS IN RARE EARTH ISOTOPES. E. Cheifetz, J. Gilat, and A. I. Yavin (Israel Atomic Energy Commission Labs., Rehovoth) and S. G. Cohen. Phys. Letters, 1: 289-90(July 1, 1962). (In English)

Alpha particles near 10 Mev were detected following thermal neutron capture in Sm^{149}, Sm^{147}, and Nd^{143}. Branching ratios to the excited states of the residual nuclei were measured. Relative probabilities of α emission to that of capture γ rays were found at 10^{-4} to 10^{-6}. Upper limits for $\sigma(n,\alpha)$ in Nd^{143}, Gd^{155}, and Gd^{157} are given. Spin and parity assignments are made for the capturing compound states in Sm^{150}, Sm^{148}, and Nd^{144}. (L.N.N.)

28125 ALPHA-GAMMA ANGULAR CORRELATIONS AND THE DISTORTED-WAVES THEORY. D. K. McDaniels and D. L. Hendrie (University of Washington, Seattle), R. H. Bassel, and G. R. Satchler. Phys. Letters, 1: 295-7(July 1, 1962). (In English)

The angular correlation between the alpha particle inelastically-scattered from the 4.43-Mev level of C^{12} and its de-excitation gamma ray was measured at various scattering angles to test theoretical predictions of the correlation parameters. Data are presented in graphical form. (L.N.N.)

28126 MEASUREMENT OF THE $\mu^- + He^3 \rightarrow H^3 + \nu$ REACTION RATE. I. V. Falomkin, A. I. Filippov, M. M. Kulyukin, B. Pontecorvo, Yu. A. Scherbakov, R. M. Sulyaev, V. M. Tsupko-Sitnikov, and O. A. Zaimidoroga (Joint Inst. for Nuclear Research, Lab. of Nuclear Problems, Dubna, USSR). Phys. Letters, 1: 318-20(July 15, 1962). (In English)

The reaction $\mu^- + He^3 \rightarrow T + \nu$ was investigated using a statistical material giving results an order of magnitude better than those obtained previously (O. A. Zaimidoroga et al., J. Expti. Theor. Phys., 41: 1804(1961)); previous experimental techniques were used. The rate of the reaction was measured to study muon-electron symmetry in

interactions of these particles with nucleons; data agree with calculations within theoretical and experimental inaccuracies. Muon-electron symmetry in lepton capture by nucleons is implied. (L.N.N.)

28127 THREE-PARTICLE EXCITATION IN Lu^{177}. M. Jørgensen, O. B. Nielsen, and G. Sidenius (Univ. of Copenhagen, Denmark). Phys. Letters, 1: 321-3(July 15, 1962). (In English)

Quantitative e-γ coincidence measurements showed that all strong transitions were coincident with 3 to 5 others. Estimates of the conversion coefficients show predominant M1 multipole order. Existence of at least two rotational cascades involving three or more levels is indicated. The 105-, 128-, and 153-kev transitions are mainly M1 and of about the same intensity. The energy ratios correspond to transitions between rotational levels having spins of $^7/_2$, $^9/_2$, $^{11}/_2$, and $^{13}/_2$. The e-γ coincidence relations support this interpretation and suggest the 282-kev transition as a cross over, whereas a 180-kev γ in the coincident spectra possibly represents a transition from a $^{15}/_2$ level. The coincidence measurements also seem to indicate coincidence with the 113- and 208-kev transitions; this is inconsistent with the spin $^9/_2$ for the 321-kev level in Lu^{177}. The 123- and 149-kev transitions with a 175-kev γ possibly form a similar cascade built on a level at 412 kev. (L.N.N.)

28128 A NEW ELECTRIC QUADRUPOLE TRANSITION IN O^{16}. G. R. Bishop and D. B. Isabelle (Ecole Normale Supérieure, Laboratoire de l'Accélérateur Linéaire, Orsay, France). Phys. Letters, 1: 323-4(July 15, 1962). (In English)

Strong enhancement of single-nucleon matrix elements for E2 transitions in nuclei neighboring O^{16} result from the virtual excitation of a collective 2^+ state in the O^{16} core (S. Fallieros and R. A. Ferrell, Phys. Rev., 116: 660 (1959)). Data are satisfactorily explained by an energy transition of about 18 Mev, containing a large fraction of the T = 0 sum rule. Results indicate that the transition is electric. (L.N.N.)

28129 THEORETICAL ANALYSIS OF THE ENERGY LEVELS IN Ne^{20}. E. Chacon and M. Moshinsky (Universidad, de Mexico). Phys. Letters, 1: 330-2(July 15, 1962. (In English)

Low levels of positive parity of Ne^{20} are analyzed using nuclear shell theory to show that the best theoretical fit to the data is given neither by the long-range correlations associated with collective motions, nor by the short-range correlations of pairing forces; an intermediate range correlation is used. This is corroborated by an analysis using an ordinary central interaction potential in which the range varies from zero to a value of the order of the nuclear radius. (L.N.N.)

28130 NUCLEAR MATRIX ELEMENTS IN THE BETA DECAY OF RaE. J. D. Ullman (Université, Strasbourg). Phys. Letters, 1: 339-41(July 15, 1962). (In English)

The Bi^{210} spectrum shape is strongly distorted, and its electron polarization is unusually low. Accidental cancellation among the usually dominant terms is assumed, allowing usually negligible energy-dependent terms to become significant. The different nuclear matrix elements contributing to the decay give different characteristic energy dependencies. Measurements of the spectrum shape and energy dependence of the electron polarization allow conclusion concerning relative contributions of these matrix elements to be made. When the fit to all the available polarization data is considered, it becomes more difficult to reconcile the results with the conserved vector current theory. (L.N.N.)

28131 RATIO OF THE ELECTRIC QUADRUPOLE MOMENTS OF Ba^{137} AND Ba^{135} NUCLEI. R. M. Williams and J. W. McGrath (Kent State Univ., Kent, Ohio). Phys. Rev., 127: 184-6(July 1, 1962).

The Zeeman-split quadrupolar resonances of Ba^{137} and Ba^{135} in barium bromide dihydrate were observed using coincident enhancement of proton magnetic resonance as a detector. It was found that Q_{137}/Q_{135} is 1.543 ± 0.003 and that the asymmetry parameter of the electric field gradient about the Ba site is 0.726 ± 0.006. (auth)

28132 ELASTIC AND INELASTIC SCATTERING OF C^{12} BY C^{12} AT 127 Mev. K. H. Wang, S. D. Baker, and J. A. McIntyre (Yale Univ., New Haven, Conn.). Phys. Rev., 127: 187-91(July 1, 1962).

An experimental survey was made of the elastic and inelastic scattering of C^{12} by C^{12} at 127 Mev. Inelastic scattering occurs for (1) Q = −4.4 Mev (exciting the 4.4-Mev level of C^{12}), (2) Q = −9.1 ± 0.3 Mev [a combination of (a) exciting the 9.65-Mev level of C^{12} and (b) exciting both C^{12} nuclei to their 4.4-Mev levels], (3) Q = 14.0 ± 0.5 Mev (exciting the 14.05-Mev level of C^{12}), and (4) possibly Q = −19 ± 1 Mev (exciting a level, or levels near 19 Mev). Angular distributions of the elastically and inelastically scattered C^{12} nuclei were obtained at 14 to 39° in the center-of-mass system. The elastic and Q = −4.4 Mev inelastic distributions show large oscillations out of phase, in agreement with Blair's phase rule. The Q = −14 Mev distribution has no oscillations larger than a maximum to minimum ratio of 1.5 to 1. (auth)

28133 RADIOACTIVE DECAY OF Pm^{148} AND Pm^{148m}. C. W. Reich, R. P. Schuman, J. R. Berreth, M. K. Brice, and R. L. Heath (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 127: 192-204(July 1, 1962).

The decay of the two Pm^{148} activities produced by neutron irradiation of fission-product Pm^{147} was studied. The half-lives are 5.39 ± 0.06 and 40.6 ± 0.4 days. The energies and relative intensities of the gamma radiation emitted in the decay of the 5.4-day activity were 0.550 (1.00), 0.910 (0.55), and 1.46 Mev (0.77). Beta absorption measurements and scintillation spectra indicated the existence of a beta branch of ~2.6 Mev from the 5.4-day state in Pm^{148} to the Sm^{148} ground state. The decay of the 41-day activity gives rise to gamma rays in Sm^{148} whose energies and relative intensities are 0.098 (0.032), 0.188 (~0.01), 0.286 (0.11), 0.309 (0.05), 0.412 (0.19), 0.431 (0.08), 0.498 (0.08), 0.584 (0.99), 0.596 (–), 0.627 (1.00), 0.723 (0.33), 0.913 (0.20), and 1.011 Mev (0.21). The results of gamma-gamma and beta-gamma coincidence experiments, with the gamma-ray energies and relative intensities, indicate the existence in Sm^{148} of levels at 0.55, 1.18, 1.46, 1.59, 1.90, 2.02, 2.09, and 2.19 Mev. Gamma-gamma directional correlation measurements were made on all the prominent gamma-ray cascades and provided spin assignments for many of the observed states. The conversion-electron spectrum of 41-day Pm^{148} indicates transitions of 60 and 75 kev in Pm and establishes that the 41-day activity is an isomeric state. A (6.5 ± 1.7)% isomeric-transition branch was observed for this state. Properties of the low-lying states of Pm^{148} are discussed. Decay schemes for the Pm^{148} activities are proposed. (auth)

28134 (d,t) REACTION STUDIES ON IRON AND NICKEL. M. H. MacFarlane (Univ. of Rochester, N. Y. and Argonne National Lab., Ill.), B. J. Raz, J. L. Yntema, and B. Zeidman. Phys. Rev., 127: 204-12(July 1, 1962).

Angular distributions and absolute cross sections were measured for the (d,t) reactions on Fe^{54}, Fe^{56}, Ni^{58}, Ni^{60}, and Ni^{61} at 21.6 Mev. Sum rules are used to interpret the

resulting reduced widths in terms of the average occupation numbers of the $1f_{\frac{7}{2}}$, 2p, and $1f_{\frac{5}{2}}$ orbits in the target ground states. The average occupation numbers are compared with the predictions of the pairing model of Kisslinger and Sorensen. Conclusion consistencies with the results of (d,p) experiments on Ni^{58} and Ni^{60} are examined. (auth)

28135 KINETIC ENERGY DISTRIBUTIONS OF FRAGMENTS FROM THE FISSION OF Au, Tl, Pb, AND Bi. R. Vandenbosch and J. R. Huizenga (Argonne National Lab., Ill.). Phys. Rev., 127: 212-16(July 1, 1962).

Single-fragment and total kinetic energy distributions were measured for fission induced by helium ions and deuterons in Au, Tl, Pb, and Bi targets. The average total kinetic energy release has the same proportionality with $Z^2/A^{\frac{1}{3}}$ found for fission of heavier elements. The widths for the total kinetic energy distributions are comparable to those observed for fission of heavy elements. A mass distribution curve was obtained by measuring the energies of coincident fragments. (auth)

28136 HALF-LIVES OF Tm^{167}, Tm^{168}, Tm^{170}, Lu^{171}, Lu^{172}, Lu^{173}, Lu^{174}, Lu^{174m}, Au^{195}, Au^{196}, AND Au^{196m}. N. A. Bonner, W. Goishi, W. H. Hutchin, G. M. Iddings, and H. A. Tewes (Univ. of California, Livermore). Phys. Rev., 127: 217-19(July 1, 1962). (UCRL-6640)

The following half-lives were measured: Tm^{167}, 9.25 ± 0.1 days; Tm^{168}, 93 ± 0.5 days; Tm^{170}, 125 ± 2 days; Lu^{171}, 8.3 ± 0.1 days; Lu^{172}, 6.7 ± 0.1 days; Lu^{173}, 499 ± 5 days; Lu^{174} and Lu^{174m}, 140 ± 10 days; and 1300 ± 150 days; Au^{195}, 185 ± 1 days; Au^{196}, 6.17 ± 0.05 days; Au^{196m}, 9.7 ± 0.1 hr. (auth)

28137 MEAN LIFE OF THE 265-kev EXCITED STATE IN As^{75}. Franz R. Metzger (Franklin Inst., Swarthmore, Pa.). Phys. Rev., 127: 220-4(July 1, 1962).

Using an ultracentrifuge to impart velocities of up to 11.5×10^4 cm/sec to a Se^{75} source, a resonance transmission experiment involving the 265-kev excited state in As^{75} was carried out. If a branching ratio Γ_0/Γ of 0.96 is assumed for this state, the transmission vs velocity data lead to a mean life $\tau_{level} = (1.57 \pm 0.10) \times 10^{-11}$ sec. This value agrees with the result of an earlier self-absorption study, but differs considerably from the mean lives deduced from resonance scattering experiments. (auth)

28138 STUDY OF THE $Al^{27}(\alpha,Be^7)Na^{24}$ REACTION FROM THRESHOLD TO 41 Mev. Norbert T. Porile (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 127: 224-30(July 1, 1962). (BNL-5952)

Excitation functions for the formation of Na^{24}, Be^7, and Na^{22} in the interaction of Al^{27} with alpha particles were measured from threshold to 41 Mev. The cross sections at 41.2 Mev are 0.33, 0.14, and 8.0 mb, respectively, and the excitation functions exhibit a sharp rise with bombarding energy. The recoil properties of the nuclides were investigated from thick-target integral range measurement at 40 Mev. The results for Be^7 are consistent with approximately equal contributions from direct interaction and evaporation processes while the results for Na^{24} and Na^{22} indicate that these nuclides are primarily formed through processes involving compound-nucleus formation. At 40 Mev, approximately 60% of the yield of Na^{24} may be attributed to the $(\alpha,\alpha He^3)$ reaction. (auth)

28139 PHOTODISINTEGRATION CROSS SECTION OF BERYLLIUM NEAR THRESHOLD. Walter John and John M. Prosser (Univ. of California, Livermore). Phys. Rev., 127: 231-5(July 1, 1962). (UCRL-6739)

The cross section for the reaction $Be^9(\gamma,n)$ was measured near threshold using gamma rays from radioisotopes. Using an Sb^{124} source (E_γ = 1.692 Mev), the cross section is 1.31 ± 0.08 mb, in agreement with a determination by Gibbons et al. Using Bi^{206} (E_γ = 1.720 Mev), the cross section is 0.93 ± 0.05 of the cross section at 1.692 Mev, while for Al^{28} (E_γ = 1.78 Mev) the cross section is 0.67 ± 0.03 of the cross section at 1.692 Mev. These results can be fitted by the single-nucleon calculation of Francis, et al., which employs Woods and Saxon potential wells. The value for the diffuseness parameter of the final state is reduced to a normal value by using the modified theory including coupling to the Be^8 core. (auth)

28140 NEW METHODS IN DIRECT INTERACTION THEORY. R. D. Amado (Univ. of Pennsylvania, Philadelphia). Phys. Rev., 127: 261-75(July 1, 1962).

Methods developed in modern field theory are applied to deuteron stripping. The contribution associated with the direct interaction mechanism is written as the product of two parts, one representing deuteron dissociation in the field of the target and the other nucleon capture by the target. The capture amplitude is written as a dispersion relation and evaluated in terms of the bound-state wave function and the optical model phase shifts for nucleon-nucleus scattering in the capturing channel. The disassociation is also expressed as a dispersion relation and evaluated in terms of the same nucleon-nucleus scattering and deuteron-target scattering on the energy shell. It is shown that the formalism allows for the distortion of the capture vertex characterized normally by an unusually large nuclear radius and explains the persistence of an angular distribution typical of the cutoff Born approximation in spite of a fluctuating yield for the reaction. (auth)

28141 HYPERFINE STRUCTURE OF Cs^{134m}. V. W. Cohen, T. Moran, and S. Penselin (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 127: 517-23(July 15, 1962). (BNL-6023)

The nuclear magnetic moment of Cs^{134m} has been measured independently of the electron-nucleus interaction energy ΔW by observing the separation of components of the doublet $(17/2, -13/2) \leftrightarrow (15/2, -15/2)$ and $(17/2, -15/2) \leftrightarrow (15/2, -13/2)$. The frequency difference $\delta\nu = 2g_I\mu_0 H$ is observed in the vicinity of a frequency minimum for each transition. The value obtained for μ_I is 1.0964(2) nm corrected for atomic diamagnetism, giving a hfs anomaly between Cs^{133} and Cs^{134m} of −0.0139(2). The direct transition near zero field has been measured to give $\Delta\nu$ = 3 684 578 640(175) cps. (auth)

28142 HYPERFINE STRUCTURE OF THE ELECTRONIC GROUND STATES OF Rb^{85} AND Rb^{87}. S. Penselin (Brookhaven National Lab., Upton, N. Y.), T. Moran, V. W. Cohen, and G. Winkler. Phys. Rev., 127: 524-8(July 15, 1962). (BNL-6022)

A study has been made of the ground states of Rb^{85} and Rb^{87} with a high-resolution atomic beam magnetic resonance apparatus. The hfs interactions have been measured to give $\Delta\nu_{85}$ = 3 035 732 439 ± 5 cps, $\Delta\nu_{87}$ = 6 834 682 614 ± 3 cps. The nuclear magnetic moment μ_I for Rb^{85} has been measured independently of $\Delta\nu$ by observing the separation between components of the doublet $(3, -1) \leftrightarrow (2, -2)$ and $(3, -2) \leftrightarrow (2, -1)$ near the frequency minimum. This frequency is given by $\delta\nu = 2g_I\mu_0 H$. The value of μ_I is calculated to be 1.348 206(45) nm without diamagnetic correction or 1.352 70(25) nm with it. The mean frequency of the doublet, 2 611 882 320 ± 20 cps, agrees with that calculated by the Breit-Rabi equation to within one part in 10^8. The value of the hfs anomaly, ${}_{85}\Delta_{87}$, is calculated to be 0.003 513 5(17). (auth)

28143 HYPERFINE-STRUCTURE SEPARATIONS AND NUCLEAR MOMENTS OF GALLIUM-68. Vernon J. Ehlers and Howard A. Shugart (Univ. of California, Berkeley). Phys. Rev., 127: 529-36(July 15, 1962). (UCRL-9991)

The atomic-beam magnetic-resonance method has been used to determine the hyperfine-structure interaction constants of 68-min Ga^{68}. Measurements performed in both the $^2P_{1/2}$ electronic ground state and the $^2P_{3/2}$ first excited state give the results: $^2P_{1/2}$, $|a| = 11.716 \pm 0.010$ Mc/sec; $^2P_{3/2}$, $|a| = 1.660 \pm 0.010$ Mc/sec, $|b| = 10.276 \pm 0.017$ Mc/sec, $b/a < 0$. The small value of the magnetic dipole interaction constant results in an inversion of the hyperfine-structure energy levels in the $^2P_{3/2}$ state. In descending order, the levels for an assumed positive-moment diagram are $F = 3/2$, $5/2$, and $1/2$. The uncorrected nuclear moments calculated from these measurements and from known constants of the stable gallium isotopes are $|\mu_I| = 0.01172 \pm 0.00006$ nm, $|Q| = 0.0313 \pm 0.0016$ b. The stated uncertainty in the magnetic moment is large enough to include the effect of a possible hyperfine-structure anomaly. The dipole and quadrupole moments have opposite signs. (auth)

28144 COULOMB EFFECTS AND THE O^{14} β-DECAY MATRIX ELEMENT. Hans A. Weidenmueller (California Inst. of Tech., Pasadena). Phys. Rev., 127: 537-44(July 15, 1962).

The change of the Fermi matrix element of the β decay of O^{14} to the first excited state of N^{14} from its value $\sqrt{2}$ due to Coulomb corrections is reestimated. It is shown, that for pure 1p-shell states the reduction is between 0.02 and 0.2%. Configuration mixing in the 1p shell may increase these figures considerably. Instead of arbitrary admixtures of higher configurations, a collective model for the presumably most important of such admixtures is considered: The model of a "breathing state" (radial density oscillation). It is shown that for sufficiently low values of the energy of the first excited breathing state compatible with experimental data for the level spectrum of the mass-14 system, the β-decay matrix element may be reduced by as much as five percent. In view of the lack of present knowledge about the breathing state and nuclear compressibility for light nuclei, it is concluded that the discrepancy between the measured values of the vector and μ-meson decay coupling constants of β decay may well be due to such an effect. (auth)

28145 COMPARISON OF THE BETA SPECTRA OF B^{12} AND N^{12}. T. Mayer-Kuckuk and F. C. Michel (California Inst. of Tech., Pasadena). Phys. Rev., 127: 545-54(July 15, 1962).

The conserved-vector-current (CVC) theory predicts a deviation from the allowed shape of the B^{12} and N^{12} beta spectra. The ratio of the shape factors of the two spectra is expected to have an energy dependence of (1.10 ± 0.17)% per Mev. If the CVC hypothesis is not invoked, this ratio is estimated to be an order of magnitude smaller. The two spectra have been measured with a magnetic spectrometer and found to give for this ratio the value (1.30 ± 0.31)% per Mev. The branching fraction of the N^{12} decay to the 7.6-Mev state of C^{12} has been determined to be (3.0 ± 0.5)%. (auth)

28146 MATRIX ELEMENTS OF THE n-p INTERACTION AND THE ODD-GROUP MODEL FOR A HEAVY NUCLEUS. Martin G. Redlich (Univ. of California, Berkeley). Phys. Rev., 127: 555-62(July 15, 1962).

In the double-closed-shell-core model, the interaction between each pair of outer nucleons is similar to that between two free nucleons. It appears possible that the wave functions for low states of odd-A heavy nuclei obtained with this model are generally approximately those of the odd-group model. Energy matrices for a zero-range, charge-independent two-nucleon potential with triplet/singlet strength ratios $\rho = 1$ and 1.5 were calculated for all states with $J = 7/2$ and $9/2$ of the configuration $(1h_{9/2}p)^2J'(2g_{9/2}n)$ of two protons (p) and one neutron (n), for Po^{211}. In an expansion of the wave function of the lowest state, with $J = 9/2$, the odd-group model wave function, characterized by $J' = 0$, has amplitude 0.97 for $\rho = 1$, and 0.92 for $\rho = 1.5$. There are four higher states with $J = 9/2$ and four with $J = 7/2$. Their wave functions have large components of two or more states with $J' > 0$, but small or zero components of the $J' = 0$ state. A more general result is valid for certain special potentials, including the pure tensor potential. (auth)

28147 Br^{86}—A NEW NUCLIDE. Andrew F. Stehney and Ellis P. Steinberg (Argonne National Lab., Ill.). Phys. Rev., 127: 563-9(July 15, 1962). (UAC-5920)

The nuclide Br^{86} has been identified by chemical separation following neutron bombardment of enriched Kr^{86}. A half-life of 54 ± 2 sec was observed. β- and γ-scintillation counting with multichannel pulse-height analysis indicate a complex beta spectrum with an end point of 7.1 ± 0.5 Mev for the most energetic component and prominent γ rays at 1.57 and 2.76 Mev. The effect of Br^{86} on the interpretation of previous data on short-lived bromine fission products is discussed. Rough values for the relative (n,p), (n,pn), and (n,α) reactions on Kr^{86} were determined as 1 : 1 : 0.05, respectively. The ratio of Se^{83} isomers formed by the (n,α) reaction is 3 : 1 in favor of the metastable state. (auth)

28148 STRUCTURE OF THE SPECTRUM OF PROTONS FROM THE $Te^{122}(n,p)Sb^{122}$ REACTION AT 14.1 Mev. Jan Turkiewicz (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Phys. Rev., 127: 570-1(July 15, 1962).

The energy and angular distributions of protons from the $Te^{122}(n,p)Sb^{122}$ reaction at 14.1 Mev were studied. The results seem to indicate that the contribution of the direct-interaction mechanism is large and that mainly single-particle levels are excited. (auth)

28149 NUCLEAR SPIN OF 9.5-HOUR Au^{194m}. Yau Wa Chan, W. Bruce Ewbank, William A. Nierenberg, and Howard A. Shugart (Univ. of California, Berkeley). Phys. Rev., 127: 572-3(July 15, 1962). (UCRL-10011)

The nuclear spin of 9.5-hr Au^{194m} has been measured by the atomic-beam magnetic-resonance method. Measurements in the $^2S_{1/2}$ electronic ground state have yielded the result I = 12, which is consistent with predictions of the simple shell mod...l. (auth)

28150 SINGLE-PARTICLE NEUTRON BOUND STATES IN IRON ISOTOPES AND IN COBALT STUDIED WITH (p,d) REACTIONS. C. D. Goodman, J. B. Ball, and C. B. Fulmer (Oak Ridge National Lab., Tenn.). Phys. Rev., 127: 574-82 (July 15, 1962).

The energy spectra of deuterons from (p,d) reactions in Fe^{54}, Fe^{56}, Fe^{57}, Fe^{58}, and Co^{59} targets were experimentally measured and angular distributions obtained for the more prominent deuteron groups. Reduced widths for exciting various final states differ widely from state to state. The deuteron groups corresponding to the strongly excited states have angular distributions which fit distorted-wave calculations for angular momentum changes of one and of three units. The energies of these groups progress systematically through the sequence of isotopes, and an attempt is made to interpret the groups in terms of single-particle neutron bound states. Definite evidence for strong residual interactions is observed. The locations and number of states suggest the applicability of the Nilsson model with the assumption that Fe^{54} and Co^{59} are spherical and

that Fe^{56}, Fe^{57}, and Fe^{58} are deformed in a prolate configuration. (auth)

28151 ft VALUE OF O^{14} AND THE UNIVERSALITY OF THE FERMI INTERACTION. R. K. Bardin, C. A. Barnes, W. A. Fowler, and P. A. Seeger (California Inst. of Tech., Pasadena). Phys. Rev., 127: 583-96(July 15, 1962).

The conserved-vector-current theory of the strangeness-conserving weak decays predicts that G_V, the vector coupling constant in nuclear beta decay, should be equal to G_μ, the coupling constant in the muon decay. To make possible a more precise comparison of G_V and G_μ, the ft value of O^{14} has been remeasured. The end-point energy of the positron decay has been determined by measuring the Q values of the reactions $C^{12}(He^3,n)O^{14}$ and $C^{12}(He^3,p)N^{14*}$ (2.311-Mev state), using the same techniques and equipment where possible in order to minimize the uncertainty in the difference of the Q values. The results of these measurements are $Q_n = -1148.8 \pm 0.6$ kev and $Q_p = 2468.4 \pm 1.0$ kev, which yield $E_{max}(\beta^+) = 1812.6 \pm 1.4$ kev, all energies relative to the $Li^7(p,n)Be^7$ threshold assumed as 1880.7 ± 0.4 kev. The half life of O^{14} has also been remeasured as 71.00 ± 0.13 sec, which implies a partial half life of 71.43 ± 0.15 sec for the transition to the 2.311-Mev state of N^{14}. Averaged with the recent half life measurement of Hendrie and Gerhart, a ft value of 3075 ± 10 sec is obtained for the O^{14} decay, after correcting for nuclear form factors, electron screening, and K-capture competition. With the radiative corrections of Kinoshita and Sirlin, the value obtained for G_V is $(1.4025 \pm 0.0022) \times 10^{-49}$ erg-cm^3, where the quoted error is experimental in origin. This is to be compared with the value computed from recent muon decay measurements, $G_\mu = (1.4312 \pm 0.0011) \times 10^{-49}$ erg-cm^3, which is $(2.0 \pm 0.2)\%$ larger. As there appear to be several possible theoretical explanations for this small discrepancy, the present results are consistent with the conserved-vector-current hypothesis. (auth)

28152 NEUTRON-PROTON INTERACTION BETWEEN STATES OF SAME I IN NUCLEAR SHELL MODEL. Bernard L. Cohen (Univ. of Pittsburgh). Phys. Rev., 127: 597-8(July 15, 1962).

Talmi has suggested that the movement of the $g_{\frac{9}{2}}$ neutron state from the top to the bottom of its major shell between $_{40}Zr$ and $_{50}Sn$ is due to a strong attractive interaction between $g_{\frac{9}{2}}$ neutrons and $g_{\frac{9}{2}}$ protons which fill in this region, arising from the fact that both are g states. Other evidence for this interaction is cited; e.g., the $h_{\frac{9}{2}}$ neutron state moves down several Mev in the region where the $h_{\frac{9}{2}}$ proton level fills (Z = 60 – 80), and the $f_{\frac{5}{2}}$ neutron level moves down considerably in the region where the $f_{\frac{5}{2}}$ proton state fills (Z = 20 – 28). Other evidence in support of this effect is presented; there is no apparent counter-evidence from nuclear level schemes. (auth)

28153 ELECTRON-PROTON COINCIDENCES IN INELASTIC ELECTRON-DEUTERON SCATTERING. M. Croissiaux (Stanford Univ., Calif.). Phys. Rev., 127: 613-16(July 15, 1962).

Electron-proton coincidences in inelastic electron-deuteron scattering were detected under the following conditions: incident beam energy 500 Mev; electron scattered at 75° and 359 Mev; proton detected at 40° 23′ (the q direction for the e-p elastic scattering). The coincidence cross-section with a D_2 target was found to be $(4.2 \pm 0.8) \times 10^{-32}$ cm^2/sr^2 Mev. The experimental result agreed, within the statistical errors, with the value calculated from a theory of Durand. One may conclude that proton form factors in a bound state and the free state do not differ significantly. (auth)

28154 REACTIONS INDUCED IN ^{12}C BY NUCLEONS OF ENERGY 120-150 Mev. S. M. Austin, G. L. Salmon, A. B. Clegg, K. J. Foley, and D. Newton (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 80: 383-94(Aug. 1, 1962).

Measurements are presented of the cross sections for producing individual states of the residual nuclei in the C^{12}(n, np)B^{11}, C^{12}(p, pn)C^{11} and C^{12}(p, 2p)B^{11} reactions. Observation of the decay γ radiation from these states provides the necessary energy resolution; the γ radiation is observed in coincidence with protons suitably selected to reject other reactions that could produce γ radiation. To a first approximation the results provide a measure of the parentage of the ground state of C^{12}; they are therefore discussed in terms of nuclear models. It is found that mirror pairs of states are produced with equal cross sections in the mirror (p, pn) and (n, np) reactions, except for the states at 4.46 Mev in B^{11} and 4.32 Mev in C^{11} where the cross sections differ by a factor of 2. The strong production of these $J = \frac{5}{2}^-$ states implies either that the ground state of C^{12} is not a pure shell-model state or that a two-stage scattering process occurs. (auth)

28155 THE ATOMIC MOTIONS IN LIQUID LEAD. K. C. Turberfield (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 80: 395-403(Aug 1, 1962).

A monochromatic beam of 4 Å neutrons is inelastically scattered from liquid lead at 340 and 520°C and from solid lead at 324°C. The observations are made at a scattering angle of 90°. The spectra of scattered neutrons observed using a molten sample show a prominent quasi-elastic peak of energy width 0.0006 ev, and an inelastic region very similar to that observed with the sample just below its melting point. Predictions based on various models of the liquid motion are compared with these observations. It is seen that free diffusion is not significant relative to motion resulting from atomic vibrations during periods of about 2.5×10^{-12} sec. (auth)

28156 EXCITATION OF THE 1s-2p TRANSITION IN HYDROGEN AND THE 3s-3p TRANSITION IN SODIUM BY NUCLEI. R. J. Bell and B. G. Skinner (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 80: 404-12(Aug. 1, 1962).

The coupled differential equations arising from an impact parameter treatment of the processes H^+ (or He^{2+}) + H(1s) → H^+ (or He^{2+}) + H(2p) and H^+ + Na(3s ^2S) → H^+ + Na(3p ^2P) are solved numerically, full account being taken of distortion, rotation coupling, and back coupling. For the former processes, cross sections are obtained for incident proton energies in the range of 10 to $100\sqrt{10}$ kev, and for incident alpha-particle energies in the range of 40 to $400\sqrt{10}$ kev. For the latter process, cross sections are obtained for incident proton energies in the range of 0.25 to 25 kev. Back coupling is found to be much more important in the case of sodium than in the case of hydrogen. The consequences of the neglect of couplings other than rotation coupling and back coupling are discussed. (auth)

28157 ELECTRON SCATTERING BY ATOMIC HYDROGEN IN THE 1s, 2s, OR 2p STATE: [PART] I. P. G. Burke (University Coll., London), V. M. Burke, I. C. Percival, and R. McCarroll. Proc. Phys. Soc. (London), 80: 413-21(Aug. 1, 1962).

A computer program is described for solving the 3 or 4 coupled integro-differential equations satisfied by the radial wave functions of an electron scattered by a hydrogen atom in a 1s, 2s, or 2p state. Strong coupling between these states is fully included, whereas all coupling with

other states is neglected. The program is satisfactory for obtaining the radial wave functions corresponding to low angular momenta, which are the most important at low incident electron energies. Solutions are checked against independent results with reasonable agreement. The full solutions may be used to obtain approximate cross sections for the six independent elastic and inelastic collisions connecting the 1s, 2s, and 2p states. (auth)

28158 ELECTRON SCATTERING BY ATOMIC HYDROGEN IN 1s, 2s OR 2p STATE. PART II. V. M. Burke (University Coll., London) and R. McCarroll. Proc. Phys. Soc. (London), 80: 422-31(Aug. 1, 1962).

The electron scattering cross sections by hydrogen in the 1s, 2s, or 2p state are computed on the basis of an approximation, which includes all coupling terms between these states but which excludes all others. Full account is taken of electron exchange. Results are obtained at low energies of impact for those states of the system with low angular momentum. The effect of coupling and exchange is found to be important. (auth)

28159 NEW NON-QUADRUPOLE TRANSITIONS IN THE L SPECTRUM OF THALLIUM 81. G. B. Deodhar and B. D. Padalia (Univ. of Allahabad, India). Proc. Phys. Soc. (London), 80: 558-9(Aug. 1, 1962).

Two transitions are observed in the L spectrum of Tl, at 1062.2 and 886.4 X units, and are assigned to classes $L_I M_I$ and $L_{II} N_{II}$ respectively. (T.F.H.)

28160 CONTRIBUTIONS TO THE STATISTICAL THEORY OF HEAVY NUCLEI. N. J. Ionescu-Pallas (Inst. of Atomic Physics, Bucharest). Rev. phys., Acad. rép. populaire Roumaine, 6: 441-55(1961). (In French)

The problem of the determination of equilibrium distributions of neutron and proton densities from the "extremum" condition of energy is complicated by the fact that the determination of the energy density expression is for the most part arbitrary. An attempt is made to realize a more complete compatibility between the nuclear magnitude. The introduction of new empirical facts, such as the independence of the shape of the nucleon distribution, of the relative excess of neutrons with respect to protons, and the invariance of the non-Coulomb part of the bonding energy at the interchange of the numbers of neutrons and protons, has reduced considerably the arbitrary choice of energy density and has made possible the consistency desired. (J.S.R.)

28161 ON THE ANGULAR AND MULTIPLICITY DISTRIBUTIONS OF SECONDARIES FROM 9 Gev PROTON COLLISIONS WITH LIGHT NUCLEI. E. M. Friedlaender, M. Marcu, and M. Spirchez (Inst. of Atomic Physics, Bucharest). Rev. phys., Acad. rép. populaire Roumaine, 6: 457-62(1961). (In English)

An analysis was made of some properties of 9-Bev proton reactions with C, N, and O nuclei in emulsions. A total of 616 jets were studied. The dependence of the average multiplicity of relativistic prongs n_s on the number of black prongs N_b was obtained. The results show that the average multiplicity is practically independent of the number of black prongs. A Pearson probability of approximately 90%, in good agreement with previous results, was obtained. Jets of small multiplicity contain a large proportion of interactions with large values of the Lorentz factor. It was proven that the angular distributions accumulated from the whole sample is not isotropic. The reasons this result cannot be explained by a unique degree of anisotropy for all jets are given. (J.S.R.)

28162 0-350 KEV GAMMA RAYS FROM THERMAL NEUTRON CAPTURE IN S, Sc, AND I. M. Cristu, D. Dorcioman, V. Cojocaru, and D. Dragomirescu (Inst. of Atomic Physics, Bucharest). Rev. phys., Acad. rép. populaire Roumaine, 6: 509-17(1961). (In English)

The level schemes of odd-odd nuclei were determined by using the energy and intensity measurements of γ rays emitted after neutron capture. Gamma spectra from Sc^{46} and I^{128} and from S in natural isotopic mixture were recorded by a scintillation spectrometer in the region from 0 to 350 kev. The apparatus and methods used are described. The spectra and absolute energies and intensities of the γ-rays from the (n,γ) reactions on S^{32}, Sc^{45}, and I^{127} are shown graphically and tabularly. The low energy level scheme of Sc^{46} is given. (J.S.R.)

28163 ANGULAR DISTRIBUTION AND CIRCULAR POLARIZATION OF THE γ RADIATION IN THE MÖSSBAUER EFFECT. A. Gelberg (Zentralinstitut fur Kernphysik, Dresden). Rev. phys., Acad. rép. populaire Roumaine, 6: 567-70(1961). (In German)

It is shown that the Mössbauer effect permits the observation of the anisotropy of γ emission and observation of its circular polarization. In an analysis of the Mössbauer effect, a radioactive nucleus in a magnetic field oriented parallel to the z axis and the γ transition from an excited state to the ground state is considered. Both energy states split into levels in the presence of a magnetic field. (J.S.R.)

28164 THE α-γ ANGULAR CORRELATION FOR FAVORED α TRANSITIONS. Mircea Iosifescu (Inst. of Atomic Physics, Bucharest). Rév. phys., Acad. rep. populaire Roumaine, 6: 589-607(1961). (In French)

After some comments on a comparison of the formalism of wave functions and the formalism of radiation parameters, numerical calculations of the α-γ angular correlations are made for the case of deformed odd nuclei having favored α transitions and pure γ transitions. The explicit formula of the α-γ directional correlation for γ transitions of the M1 + E2 type between two successive rotational levels of the nucleus was derived. This formula shows that in the absence of polarization of the γ radiation, the α-γ angular correlation depends only on the square of the internal quadrupole moment and the square of the difference of the gyromagnetic factors. The formulas obtained were applied to U^{233}, Am^{241}, and Am^{243}, and the values obtained are tabulated. (J.S.R.)

28165 ABSORPTION OF PHOTONS IN THE REGION FROM 10-20 Mev MEASURED IN P^{31} AND Pr^{141}. Ottavia A. Borello. Rev. union mat. arg. y asoc. fis. arg., 19: 251-66(1961). (In Portuguese)

The total absorption coefficient for photons in P^{31} and Pr^{141} was measured using threshold detectors. The experimental and theoretical results were compared graphically. For P^{31} the experimental and theoretical cross sections at 11.0 and 16.5 Mev coincide, but for 19.5 Mev the experimental cross section is larger. The discrepancy is attributed to nuclear absorption. For Pr^{141} the experimental absorption coefficient coincides with the electron absorption coefficient at 11.2 Mev. But at 14.6, 16.6, and 19.6 Mev, the measured absorption coefficient is larger than the electron cross section. (J.S.R.)

28166 ON THE MOMENT OF INERTIA OF LARGE NUCLEAR SYSTEMS WITH PAIRING FORCES. P. Mittelstaedt (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Physik, 168: 6-9(1962). (In English)

The moment of inertia of large nuclear systems with pairing forces was shown to be that of an irrotational flow by Prange. Following an argument due to Thirring, a very simple derivation is given of this important result. (auth)

28167 THE GYROMAGNETIC RATIO OF THE 2^+ ROTATIONAL LEVEL OF Hf^{178} AND FURTHER INVESTIGATIONS ON THE DECAY OF W^{178}. E. Bodenstedt, H. J. Koerner, E. Gerdau, J. Radeloff, K. Auerbach, L. Mayer, and A. Roggenbuck (Physikalische Staatsinstituts, Hamburg). Z. Physik, 168: 103-14(1962). (In German)

The nuclear g-factor of the 2^+ rotational state of Hf^{178} was determined by a measurement of the rotation of the angular correlation between the gamma group of ~1350 and the 93 kev radiation in an external magnetic field of 49,550 gauss. The result is: $g_R = +0.356 \pm 0.035$. Liquid sources of 21-day W^{178} (ammonium tungstate in aqueous solution) in equilibrium with 9.3-min Ta^{178} were used for these measurements. Differential angular correlation measurements showed the existence of a strong time dependent attenuation. The observed attenuation parameters are: $\lambda_2/\lambda = 0.85 \pm 0.23$, $\lambda_4/\lambda = 0.74 \pm 0.10$. The true coefficients of the angular correlation between the gamma group of ~1350 and the 93 kev radiation were derived as: $A_2 = +0.330 \pm 0.047$, $A_4 = +0.990 \pm 0.060$. As they are substantially larger than previously published values a reinterpretation of the correlation function is given. The half-life of the 93-kev state was found to be $T_{½} = (1.49 \pm 0.05) \times 10^{-9}$ sec in good agreement with the Coulomb excitation data. (auth)

28168 THE β SPECTRUM OF Cs^{137}. H. Daniel and H. Schmitt (Max-Planck-Institut für Kernphysik, Heidelberg). Z. Physik, 168: 292-7(1962). (In German)

The β spectrum of Cs^{137} was measured with an iron-free spectrometer. The energy of the soft component was found to be $E_0 = 514 \pm 2$ kev. The parameter k of the hard component shape factor $C^{(2)}_{2\nu A}(W) = q^2 + kp^2$ was determined to be $k = 0.015 \pm 0.004$. The β intensities amount to 6.5% (hard component) and 93.5% (soft component). The K conversion coefficient of the isomeric transition was measured to be $\alpha_k = 0.093 \pm 0.003$, in excellent agreement with Sliv's theoretical value. (auth)

28169 LIFETIME MEASUREMENT OF THE 84-kev TRANSITION IN Yb^{170}. M. S. El-Nesr and E. Bashandy (Univ. of Uppsala). Z. Physik, 168: 349-52(1962). (In English)

The half life of the first excited state in Yb^{170} was measured by delayed beta-electron coincidence technique. The value of $T_{½} = (1.61 \pm 0.06) \times 10^{-9}$ sec was obtained. The transition probability was calculated and compared with the estimated value from the single particle model. An enhancement factor of 169 was found. The intrinsic quadrupole moment Q_0 and the deformation parameter β were determined. (auth)

28170 ELEMENTS DE PHYSIQUE NUCLEAIRE. (Elements of Nuclear Physics). Daniel Blanc and Georges Ambrosino. Paris, Masson et Cie, 1960. 238p.

An experimentally oriented survey is given of various topics, such as: the history of research on the structure of the atom, atomic energy, and nuclear reactions; the structure and stability of the atom; nuclear data; radioactive decay; nuclear reactions; production and properties of neutrons; nuclear fission and chain reactions; nuclear structure and cohesion; nuclear models; and thermonuclear reactions and reactors. (T.F.H.)

28171 RADIONUKLID-TABELLEN NACH NUKLIDEN GEORDNETE UBERSICHT DER EMITTIERTEN KERNSTRAHLEN ALLER NUKLIDE MIT EINER LANGEREN HALBWERTSZEIT ALS 1 STUNDE. (Radionuclide Tables Arranged According to Nuclides with a Summary of the Radiation Emitted by all Nuclides with Half-life Greater than One Hour). W. Seelmann-Eggebert and G. Pfennig. Berlin, Telefunken G.M.B.H., 1961. 67p.

Tables of radionuclides are presented which give the decay radiation, half life, radiation energy, and processes for radionuclide production. (D.L.C.)

Particle Accelerators

Refer also to abstracts 26690, 27378, and 27379.

28172 (AERE-Memo-G/M-117) PROPOSED SCHEME FOR EXTRACTING THE ELECTRON BEAM FROM THE MALVERN 30 Mev SYNCHROTRON. J. D. Lawson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Jan. 10, 1949. 5p.

Investigation revealed that ejection of the electron beam from the 30-Mev synchrotron with the aid of two moderate sized modulators and coils should be possible. One coil would be used to disturb the guide field in such a way that the radially unstable region moves inward, causing the electrons to spiral outward, while the other would produce a stable track of zero field along which the electrons could move out of the doughnut. (J.R.D.)

28173 (DESY-A1.10) ARBEITSBERICHTE DER GRUPPEN M1-M8 VORGETRAGEN IN DER SITZUNG DES WISSENSCHAFTLICHEN RATES AM 15.12.1961. (Work Report of Group M1-M8 Delivered in the Meeting of the Scientific Council December 15, 1961). (Deutsches Elektronen-Synchrotron, Hamburg). Apr. 11, 1962. 46p.

A progress report is given of the work done by Groups M1-M8 in the construction of DESY. The M1 group has concentrated its study on radiation effects, intensity limitation by space-charge phenomena, and beam recoil effects on the high-frequency system. Preliminary results on the study of radiation effects indicate that the utilization of closed orbits, which do not agree with an isomagnetic line, causes a damping of the radial betatron oscillations. The space-charge limit is higher by a factor of 10 than the planned intensity of 10^{11} electrons/pulse. Group M2 reported on the magnet sector measurements made, and the discrepancies between calculation and measurement. The high-frequency Group M3 described the HF power generator, the acceleration gap length, the ring circuit, and the construction of the high frequency plant. The tests performed on the 40-Mev linear accelerator by Group M4 are described, and resulted in the acceptance of this device. Group M5 is concerned with operation and control, and a brief review is given of their work. The power supply for the magnet and cooling devices were reported by Group M6. Group M7 described the construction of the ring foundation and the vacuum chamber. Beam control for experimental purposes is the concern of Group M8, and their work is briefly discussed. (J.S.R.)

28174 (DESY-A2.86) KOSTEN DER DESY-BAUTEILE UND IHRES AUFBAUES. (Cost of the DESY Buildings and their Construction). (Deutsches Elektronen-Synchrotron, Hamburg). Apr. 17, 1962. 16p.

A cost break-down is given for the construction of the Hamburg Electron Synchrotron. The total of 99.20 MDM was obtained from a cost analysis of the buildings, linear accelerator, magnet, high-frequency system, operation and control, power supply, vacuum installation, personnel expenses, general expenses, and auxiliary equipment. (J.S.R.)

28175 (PAN-299/I-A) ELEKTROSTATICHESKII USKORITEL POD DAVLENIEM "LEKH." (Pressurized Electrostatic Accelerator "Lech"). L. Bobrovski,

Z. Wilhelmi (Vil'gel'mi), E. Gurski, A. Martsinkovski, A. Soltan, and M. Yaskula (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Mar. 1962. 45p.

A description is presented of the 3-Mev pressurized electrostatic accelerator which is in operation at the Institute of Nuclear Research in Warsaw. (J.R.D.)

28176 (TID-7636) INTERNATIONAL CONFERENCE ON HIGH ENERGY ACCELERATORS, SEPTEMBER 6-12, 1961. M. Hildred Blewett, ed. (Brookhaven National Lab., Upton, N. Y.). Contract [AT-30-2-GEN-16]. 499p.

A total of 54 papers is included for each of which a separate abstract was prepared. (J.R.D.)

28177 (TID-7636(p.3-5)) THE FUTURE OF HIGH-ENERGY PHYSICS. Robert Serber (Columbia Univ., New York).

A discussion emphasizing the future use of accelerators is presented. It is noted that the central problem of high-energy physics is the nature of elementary particles. Aspects of high-energy processes such as jets, symmetry laws, and weak interactions are examined. Other discussion concerns the role of theorists and the development of theoretical physics especially as concerns the formal structure of field theory. (J.R.D.)

28178 (TID-7636(p.6-12)) THE ROLE OF HIGH ENERGY ACCELERATORS IN PARTICLE PHYSICS. L. Van Hove (European Organization for Nuclear Research, Geneva).

a review is presented of the current situation concerning very high-energy phenomena. Included are discussions concerning weak, electromagnetic, and strong interactions. The main questions with which high-energy physics is likely to be concerned in the near future are considered separately in each of these areas. The energy region considered begins at the maximum energies now studied in accelerator laboratories and extends to the range where cosmic rays are the only present source of information. (J.R.D.)

28179 (TID-7636(p.15-22) PARTICLE PRODUCTION BY HIGH-ENERGY ACCELERATORS. R. L. Cool (Brookhaven National Lab., Upton, N. Y.).

A summary of data and information gained recently concerning secondary particles obtained by operation of the CERN synchrotron and Brookhaven AGS at energies up to 33 Bev is presented. Discussions are also included concerning the practical aspects of the data for use of existing accelerators, the effects on the design of new high-energy machines, and the implications of the data on the theory of high-energy production processes. (J.R.D.)

28180 (TID-7636(p.25-38)) PERFORMANCE OF THE CERN PROTON SYNCHROTRON. M. G. N. Hine and P. Germain (European Organization for Nuclear Research, Geneva).

A review of the CERN synchrotron performance is presented with comment concerning the design of an enlarged machine of this type. The experimental use of the CERN synchrotron is also reviewed with similar comment concerning future projects. (J.R.D.)

28181 (TID-7636(p.39-53)) SOME OPERATING CHARACTERISTICS OF THE BROOKHAVEN ALTERNATING GRADIENT SYNCHROTRON. (Brookhaven National Lab., Upton, N. Y.).

A review of early operation of the AGS is presented together with present operating experience and comment concerning design and performance. (J.R.D.)

28182 (TID-7636(p.57-63)) DESIGN OF A 10 Bev FFAG ACCELERATOR. (Midwestern Universities Research Assn., Madison, Wis.).

An outline is presented concerning the major areas of work in the accelerator design. A discussion of the FFAG uses in high-energy physics is included in which it is noted that the design goal of accelerating 2×10^{14} particles per second is a factor of 3,000 more than the number available from Brookhaven and CERN. (J.R.D.)

28183 (TID-7636(p.65-9)) A PROPOSED 12 Gev PROTON SYNCHROTRON. T. Kitagaki (Tohoku Univ., Sendai, Japan).

The design study was recently initiated and it is noted that full particulars of the proposal are yet to be discussed. The proposal outline includes design concepts for the injector, magnet, r-f acceleration, experimental rooms, and a second ring. Parametric data are tabulated. (J.R.D.)

28184 (TID-7636(p.73-8)) HIGH ENERGY LINEAR ACCELERATORS. Lloyd Smith (California. Univ., Berkeley. Lawrence Radiation Lab.).

Information concerning linear proton accelerators with energies ranging from 200 Mev to 10 Bev is reported. Included is a review of developments and thinking concerning machines for such acceleration, and a report of groups actively studying extensions of them. These groups are MURA, Yale, Harwell, Berkeley-Cal Tech-Brookhaven, and Tokyo Universities. A discussion of the differences in the characteristics of electron and protron accelerators as pertains to phase velocity, pulse length, transverse focusing, and phase motion is also included. (J.R.D.)

28185 (TID-7636(p.79-118)) LINEAR ELECTRON ACCELERATOR PROGRESS AT STANFORD UNIVERSITY. K. L. Brown, A. L. Eldredge, R. H. Helm, J. H. Jasberg, J. V. Lebacqz, G. A. Loew, R. F. Mozley, R. B. Neal, W. K. H. Panofsky, and T. F. Turner (Stanford Univ., Calif.).

Progress during the last several years at Stanford University is reported in certain areas of electron linear accelerator technology. Much recent work was related to specific design of a 2-mile-long electron linear accelerator. A discussion of general design considerations for the 2-mile machine is presented along with discussions of beam dynamics, accelerator structures, methods of accelerator structure fabrication, drive and phasing, klystrons, and modulators. (J.R.D.)

28186 (TID-7636(p.119-23)) SUPERCOOLED PROTON LINEAR ACCELERATORS. J. M. Dickson (Gt. Brit. National Inst. for Research in Nuclear Sciences. Rutherford High Energy Lab., Harwell, Berks, England).

A report which indicates the feasibility and advantages of using superconducting cavities for proton linear accelerators is presented. Descriptions are included of superconductors, r-f dissipation, beam loading, refrigeration, focusing, and costs. A leading problem area is construction of large superconducting cavities of low r-f surface resistivity. Other problems include proton beam focusing and the effects of multipactor loading during build-up of the r-f fields. (J.R.D.)

28187 (TID-7636(p.124-8)) ON A DESIGN OF THE DISK-LOADED PROTON LINEAR ACCELERATOR. Tetsuji Nishikawa and Hiroo Kumagai (Tokyo Univ.).

The recent development of L-band linear electron accelerators may lead to important gains in proton linear accelerators, and it is believed that the feasibility of beam focusing in the L-band disk-loaded proton linac should be re-examined. The proton linear accelerator is capable of producing an intense high-energy beam with the possibility of an external beam. By careful focusing, as much as 30 μa average output can be expected in the multi-Bev range. (J.R.D.)

28188 (TID-7636(p.129-41)) SHAPED DRIFT TUBES AND IRISES FOR LINEAR ACCELERATORS. R. L. Gluckstern (Yale Univ., New Haven).

A method was used which allows calculation of a drift tube as a surface everywhere perpendicular to an electric field configuration given by an exact expansion. The exact field corresponds to a pair of charges, connected by a current-carrying conductor, placed on the axis of the cavity. The main investigations were with fields associated with one and two dipoles. Included are discussions and mathematical analyses concerning field expressions for shaped drift tubes, and calculations and results on these tubes. Field expressions for shaped irises are also included along with calculations and results. (J.R.D.)

28189 (TID-7636(p.145-54)) DESIGN CONCEPTS FOR ULTRA-HIGH ENERGY SYNCHROTRONS. Matthew Sands (California Inst. of Tech., Pasadena).

It is believed that the most straightforward and economical path to attainment of higher energies is the A.G. synchrotron. Further discussion concerning extension of the AGS machines to higher energies is presented including the guide field design, magnet alignment, injection, and acceleration. Utilization of the higher energy machines is also discussed and it is noted that the way is opening for construction of accelerators with energies 10 or more times higher than the largest existing machines. (J.R.D.)

28190 (TID-7636(p.155-9)) DESIGN OF HIGH INTENSITY A.G. PROTON SYNCHROTRONS OF 5 TO 25 Gev. Henri Bruck (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay).

It is noted that the primary interest at Saclay is in machines with energies of 5 to 25 Bev with resonant magnet power supply. Such machines are appropriate as injectors to an associated single storage ring, or an intermediate machine in a cascade accelerator. The cross section of the chamber is limited. A description and analysis of the acceleration method is given including optimizing of current and r-f power, minimizing of magnet and magnet power supply, and excursion of the closed orbit. (J.R.D.)

28191 (TID-7636(p.163-74)) LONGITUDINAL INSTABILITY AND CLUSTER FORMATION IN THE COSMOTRON. M. Q. Barton (Brookhaven National Lab., Upton, N. Y.) and C. E. Nielsen (Midwestern Universities Research Assn., Madison, Wis.).

A report of observations is presented concerning the longitudinal negative mass instability as manifested in the Cosmotron, and concerning formation of clusters of charges bound by their mutual repulsion. The method of observation is described and discussion of the observed phenomena using a coasting beam, and a beam with r-f is presented. Details of the stationary states and cluster theory is included along with a discussion of accelerator intensity. (J.R.D.)

28192 (TID-7636(p.175-84)) STUDY OF THE BEHAVIOR OF THE BEAM IN THE PROTON SYNCHROTRON, "SATURNE." H. Bruck, G. Gendreau, M. Gouttefangeas, J. Hamelin, R. Levy-Mandel, and R. Vienet (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay).

Work undertaken to increase the intensity of the Saturne synchrotron is described. Measurements were made to determine the number of surviving protons during injection and at r-f capture. Results of calculations and experiments showed the importance of space charge effects in this machine. It was found theoretically possible to increase the number of accelerated particles, however this result is restricted by the fact that one of the formulas used does not take into account the increase of radial and vertical amplitudes that exist which may make the estimate optimistic. Methods of decreasing space charge effects are discussed along with plans for increasing efficiency by injection with increasing energy. (J.R.D.)

28193 (TID-7636(p.187-93)) A STUDY OF THE BEAM STACKING PROCESS. Donald A. Swenson (European Organization for Nuclear Research, Geneva).

A statistical study was made of an accelerator beam-stacking process using an IBM 709 computer. A method was developed for evaluating the effect of this process on a stacked beam of any given spectrum. Included are discussions of the beam stacking process, the experimental method used, and results. It was concluded that the stacking process studied is reasonably efficient provided that a sufficiently large number of accelerating buckets are stacked. (J.R.D.)

28194 (TID-7636(p.194-200)) HIGH TRAPPING EFFICIENCY IN SYNCHROTRONS WITH PHASE LOCK. Kjell Johnsen (European Organization for Nuclear Research, Geneva).

A theoretical explanation is presented for a special trapping mechanism discovered in the CERN synchrotron. The effect is treated analytically by assuming nonaccelerating buckets. A few computational results for accelerating buckets corresponding to the CERN PS are included in addition to the analytic treatment. It was concluded that early take-over by the phase-lock system proton synchrotrons is possible and under suitable conditions is desirable, since the r-f parameters can be arranged so that the synchrotron itself behaves like a buncher. Improvement of the trapping efficiency depends on the energy spread of the injected beam which should be kept as small as possible. (J.R.D.)

28195 (TID-7636(p.201-5)) COMPUTER STUDIES OF PHASE-LOCK ACCELERATION. E. D. Courant (Brookhaven National Lab., Upton, N. Y.).

A computer program to study the acceleration process in synchrotrons with phase locks is described. Results obtained by application of the program to the Brookhaven machine are discussed. (J.R.D.)

28196 (TID-7636(p.206-11)) FIRST APPROXIMATION THEORY OF BUNCHING. H. Zyngier (Paris. Université, Orsay. École Normale Supérieure. Laboratoire de l'Accélerateur Linéaire).

An analysis concerning the theory of bunching is presented. An integration was performed of the equations which are valid in the case of electron movement for purely longitudinal motion, and when the axial electric field is considered a pure sinusoidal wave. The computation is discussed along with a constant field accelerator, fast wave bunchers, and slow wave bunchers. (J.R.D.)

28197 (TID-7636(p.212-16)) PROPOSAL OF USING THE ACCELERATING RF FOR BEAM BUNCHING OR DEBUNCHING. Lee C. Teng (Argonne National Lab., Ill.).

A method is proposed of longitudinal phase-area shaping, using the accelerating r-f in the accelerators to supply the bunching or debunching action. An analysis of the proposal shows that acceleration on the stable synchronous phase gives a longitudinal focusing (bunching), action which is approximately linear and that acceleration on the unstable synchronous phase gives a longitudinal defocusing (debunching) action. The advantage of this mode of longitudinal phase-area shaping over conventional buncher-debuncher method is that shaping is carried out here simultaneously with the acceleration inside the accelerator using the same r-f thereby eliminating the need for additional physical space, and the buncher-debuncher cavities. (J.R.D.)

28198 (TID-7636(p.217-21)) THE A.G. SYNCHROTRON WITH SUPER-PERIOD STRUCTURE. J. R. Holt and H. C. Newns (Liverpool. Univ.).

A study was conducted to design an alternating-gradient electron synchrotron in which a few of the straight sections between magnets were made extra long to provide ample space for injection, extraction, and target arrangements. These straight sections, symmetrically placed around the machine, split the magnet structure into a number of super-periods. A method is described of minimizing stop bands which occur between the super-periods so as to obtain an exact match for both the betatron oscillations and the momentum deviations. (J.R.D.)

28199 (TID-7636(p.222-6)) MEANS OF DAMPING RADIAL BETATRON OSCILLATIONS IN STRONG FOCUSING ELECTRON RINGS. H. G. Hereward (European Organization for Nuclear Research, Geneva).

The dependence of betatron antidamping oscillation caused by radiation in CERN storage rings on the choice of beam position across the available horizontal aperture of the vacuum chamber is considered. It was concluded that in a strong-focusing structure like that of the CERN synchrotron electrons could be accelerated or stored without radiation antidamping by keeping the beam center in a region a little inward from the center of the vacuum chamber. This safe region can be moved or widened by adding sets of special magnets in the straight sections of the machine. (J.R.D.)

28200 (TID-7636(p.227-35)) RESONANT INJECTION AND EJECTION FOR SECTOR-FIELD ACCELERATORS. Lee C. Teng (Argonne National Lab., Ill.).

A general analytical treatment is presented for studying the motion of ions in a sector-field accelerator (nonlinear free oscillation) under the influence of small but arbitrary field bumps which are approximately in resonance with free oscillation. The general method of analysis is further illustrated by a specific example to show the derivation methods for handy approximate formulas to give the near-resonant behaviors of ion motions. (J.R.D.)

28201 (TID-7636(p.236-43)) SECOND-ORDER EFFECTS IN BEAM-CONTROL SYSTEMS OF PARTICLE ACCELERATORS. H. G. Hereward (European Organization for Nuclear Research, Geneva).

The possibility of a beam-control phenomenon that might cause antidamping of bunch-shape oscillations in the CERN synchrotron was discussed. Results of a study are presented to show that with the beam-control system used in the CERN, significant damping of bunch-shape oscillations are expected. It is noted the possibility of beam-control system causing anti-damping of these oscillations cannot be excluded. Study results also show that it may be possible to devise, or modify, a beam-control system in such a way that bunch-shape oscillations are damped at an increased rate, making it possible to relax certain tolerances or to obtain more reproducible beam behavior. (J.R.D.)

28202 (TID-7636(p.247-55)) COMPONENT DESIGN AND TESTING FOR THE PRINCETON-STANFORD COLLIDING-BEAM EXPERIMENT. G. K. O'Neill (Princeton Univ., N. J.).

Design and test results related to the 500-Mev colliding-electron-beam experiment are presented. Included are discussions of the magnets, pulsed injectors, beam position sensing, and ultra-high vacuum systems. (J.R.D.)

28203 (TID-7636(p.256-61)) A 250-Mev ELECTRON-POSITRON STORAGE RING: THE "A d A." C. Bernardini, U. Bizzarri, G. F. Corazza, G. Ghigo, R. Querzoli, and B. Touschek (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

A report concerning the design and operation of the 250-Mev (500-Mev total center-of-mass energy) electron-positron storage machine at Frascati, Italy, is presented. Included are sections concerning stored beam lifetime and storage, the injection system, and observations of e^+, e^- reactions. (J.R.D.)

28204 (TID-7636(p.262-4)) DESIGN OF ELECTRON-POSITRON COLLIDING BEAM RINGS. F. Amman and D. Ritson (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

Considerations entering into the design of an electron-positron colliding-beam ring are outlined. It is noted that the most important limitation is set by the space-charge interaction of two beams. Calculations concerning this interaction are included. (J.R.D.)

28205 (TID-7636(p.265-71)) FEASIBILITY OF STORAGE RINGS FOR THE CERN PROTON SYNCHROTRON. H. G. Hereward, K. Johnsen, A. Schoch, and C. J. Zilverschoon (European Organization for Nuclear Research, Geneva).

The feasibility of storage rings for use in colliding-beam experiments at the CERN PS is discussed. Included in the discussions are the general layout, possibility of storing particles other than protons, incidental usefulness, expected performance, and tentative design parameters. It is felt that the storage-ring system is feasible. (J.R.D.)

28206 (TID-7636(p.272-7)) PART I. BEAM STABILITY AGAINST INTERACTION-REGION FORCES IN A PROTON STORAGE RING. E. J. Woods (Princeton–Pennsylvania Accelerator, Princeton, N. J.).

Computer calculations were made to determine the effects of the interaction-region forces on the stability of the stored beam in storage rings in high-energy proton accelerators. The calculations were made to determine if the nonlinear bump received by a particle in crossing the other circulating beam leads to instability. Results were obtained for various current values. (J.R.D.)

28207 (TID-7636(p.278-90)) PART II. MAGNET CELL STRUCTURES FOR CONCENTRIC STORAGE RINGS. Franz Gross (Princeton–Pennsylvania Accelerator, Princeton, N. J.).

An investigation is reported to choose magnet cell structures for concentric storage rings (CSR). The study was carried out with the aid of an IBM-704 computer using a program designed to minimize functions of the betatron amplitude function β and the linearized equilibrium orbit Y. It is concluded that although design criteria for a CSR are different from those for a conventional machine, satisfactory cell structures can be found. (J.R.D.)

28208 (TID-7636(p.294-8)) PART I. NON-SUPERCONDUCTING ELECTROMAGNETS. C. E. Taylor and R. F. Post (California. Univ., Livermore. Lawrence Radiation Lab.).

A review concerning development and use of cryogenic magnets is presented. Included is a discussion of power considerations, experimental work with Cu, Al, and Na, and development problems such as insulation, heat leak in leads, and mechanical support. It is noted that this technique may be useful in auxiliary equipment such as bubble chambers or large solenoidal spectrometers. (J.R.D.)

28209 (TID-7636(p.299-308)) PART II. SUPERCONDUCTING MAGNETS. Paul R. Aron, H. Paul Hernandez, and Harley C. Hitchcock (California. Univ., Berkeley. Lawrence Radiation Lab.).

A review of superconducting material development is presented along with a résumé of superconductor activities at Berkeley. Included are discussions concerning tests with superconducting wires, tests with small solenoids, and coil design. Two superconducting materials, Nb_3Sn and Nb–Zr alloys achieve high field tests with wires 6 cm long. More coil tests are required to determine the relations of wire length and critical current. It is noted that the only reliable acceptance test for superconducting wire at present is to try it. (J.R.D.)

28210 (TID-7636(p.311-14)) EFFICIENT BEAM EXTRACTION AT n = 1 AND DEBUNCHING OF THE BEAM FOR THE SYNCHROCYCLOTRON. J. Sanada, S. Suwa, and A. Suzuki (Tokyo Univ. Inst. for Nuclear Study).

Improvements on synchrocyclotron beam extraction and beam debunching are reported. An over-all efficiency of 60% for the beam extraction confined within 2.5 cm diameter area at the vacuum tank exit port was achieved by insertion of a magnetic channel acting as a focusing lens. A technique of superposing both modulations achieved almost complete debunching. (J.R.D.)

28211 (TID-7636(p.317-23)) SOME RECENT DEVELOPMENTS IN FFAG ACCELERATORS. F. T. Cole (Midwestern Universities Research Assn., Madison, Wis.).

It is noted that the most concentrated work has taken place at MURA in the development of FFAG accelerators. The efforts of the MURA group were concentrated mainly on the two-way electron model and on the design of a 10-Bev proton spiral-sector FFAG accelerator. A review of support work in these two projects is given. (J.R.D.)

28212 (TID-7636(p.324-43)) A STUDY OF ORBITS IN TWO-WAY SCALING FFAG SYNCHROTRONS. M. J. Pentz and N. Vogt-Nilsen (European Organization for Nuclear Research, Geneva).

Computational results pertaining to linear and nonlinear orbits in two-way scaling FFAG synchrotrons are presented. The main emphasis is on machines with sinusoidal field flutter functions and without superperiods; however, a preliminary study of the effect of straight sections of a particular idealized form is made. It is concluded that the FFAG accelerator is not a convenient device for study of beam stacking processes. (J.R.D.)

28213 (TID-7636(p.344-51)) PROGRESS ON THE MURA TWO-WAY ELECTRON ACCELERATOR. (Midwestern Universities Research Assn., Madison, Wis.).

Assembly of the two-way FFAG electron accelerator was completed in 1959. Beams of electrons were accelerated simultaneously in both directions up to 27 Mev at which point both beams were completely lost. After some subsequent trials, it was decided that the magnetic field needed additional correction. The machine was disassembled for major modification. A discussion of alterations is presented along with an account of post-modification operations. (J.R.D.)

28214 (TID-7636(p.355-69)) INITIAL PERFORMANCE OF AN EIGHT-SECTOR ELECTRON CYCLOTRON. J. A. Martin, J. E. Mann, and R. S. Livingston (Oak Ridge National Lab., Tenn.).

Aspects of design and construction of the ORNL 450-kev electron cyclotron are reviewed. Observations concerning performance during the first weeks of operations are also included. In early operation, at least 1,200 turns were achieved in acceleration to full energy. Considerably improved performance is expected with a more appropriate electron source and with coils to neutralize the geomagnetic field effect. (J.R.D.)

28215 (TID-7636(p.373-8)) THE POLARIZED PROTON SOURCE OF THE RUTHERFORD LABORATORY LINEAR ACCELERATOR. J. M. Dickson (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England).

A discussion is presented concerning the development of this source. Included are sections dealing with operation principles, conditions governing polarization, source design and construction, and aspects of operation such as measurement of polarization and intensity. (J.R.D.)

28216 (TID-7636(p.379-84)) A POLARIZED ION SOURCE USING THE ATOMIC-BEAM MAGNETIC-RESONANCE METHOD. C. W. Drake, D. C. Bonar, R. D. Headrick, and V. W. Hughes (Yale Univ., New Haven. Josiah Willard Gibbs Research Labs.).

An accelerated beam of completely polarized deuterons was obtained using this method. The apparatus used to obtain the beam consisted of a deuterium atom source, an atomic-beam magnetic-resonance system, an electron bombardment ionizer, and a 150 kv electrostatic accelerator. The intensity of the polarized beam is about 2×10^{-11} ampere. The unpolarized background beam is about 2×10^{-10} amp consisting primarily of D_2^+ ions which could be removed. A summary of polarized ion source operating characteristics is included. (J.R.D.)

28217 (TID-7636(p.385-94)) A PULSED HIGH-CURRENT SOURCE AND ASSOCIATED FOCUSING SYSTEM. A. Yokosawa (Argonne National Lab., Ill.).

Investigations concerning characteristics of a high-current proton source were conducted for use in the Argonne Zero-gradient Synchrotron (ZGS). Included is a description of the source, experimental arrangement, and source performance. For production of higher proton currents, a duo-plasmatron source was devised in which the discharge is intensified in the region between the intermediate electrode and the anode by an inhomogeneous magnetic field. Suitable lenses for use with the duo-plasmatron source were examined. Methods of reducing aberration are reported and the direction for further studies is discussed. (J.R.D.)

28218 (TID-7636(p.395-400)) MULTITURN INJECTION INTO FFAG ACCELERATORS. F. E. Mills and D. C. Morin (Midwestern Universities Research Assn., Madison, Wis.).

A multiple perturbation scheme for FFAG accelerator multiturn injection is analyzed which minimizes nonlinear difficulties associated with the single perturbation scheme by requiring that the perturbed equilibrium orbit be different from the unperturbed equilibrium orbit over only a small fraction of the accelerator circumference. Computations of the required strength of perturbation is included. The results are interpreted using a specific accelerator. It is shown that in a 10-Bev accelerator of 70-meter radius, there is sufficient radial phase space for 370 turns of linac beam. An efficiency of 25 to 30% filling of radial phase space is sufficient to get 100 turns, or a current of the order of 1 ampere. (J.R.D.)

28219 (TID-7636(p.401-5)) LINAC INJECTION INTO THE CORNELL 1.3 Bev ELECTRON SYNCHROTRON. Raphael Littauer (Cornell Univ., N. Y. Lab. of Nuclear Studies).

Performance of a 10-Mev linac injector for the Cornell 1.3-Bev synchrotron is reported. Included are data and discussion concerning synchrotron acceptance, linac emittance, inflector, and injection system. Observations of performance are reported in terms of estimated capture effi-

ciency, acceptance time, saturation effects, and r-f acceleration. (J.R.D.)

28220 (TID-7636(p.409-13)) SHIELDING OF HIGH-ENERGY ACCELERATORS. Edwin A. Crosbie (Argonne National Lab., Ill.).

Aspects of accelerator shielding are discussed. Information gained from study of cosmic radiation is discussed along with recent shielding experiments with the CERN synchrotron. Information presented at the 1957 New York Shielding Conference is reviewed, and recent calculations by other workers are examined. (J.R.D.)

28221 (TID-7636(p.417-21)) BEAM EXTRACTION FROM AN FFAG ACCELERATOR. F. E. Mills, J. A. Mogford, C. A. Radmer, and M. F. Shea (Midwestern Universities Research Assn., Madison, Wis.).

An experiment to demonstrate a beam-extraction method is described in which localized electromagnetic perturbation (kicker) was turned on during a short time compared with the particle revolution period, shifting the radial momentum of the beam to introduce a betatron oscillation of sufficient amplitude to send the particles past a septum located in the field-free region between the spiral magnets. The size of the beam to be extracted from the spiral-sector model was chosen to be the same fraction of its stability limits as that of an adiabatically damped beam at high energy in a large accelerator. Measurements revealed that the phase-space areas of an accelerator beam occupying the full aperture of the kicker are 12×10^{-3} cm rad radially and 8×10^{-3} cm rad vertically. (J.R.D.)

28222 (TID-7636(p.422-32)) THEORETICAL BEAM-HANDLING STUDIES AT THE RUTHERFORD LABORATORY. N. M. King (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Harwell, Berks, England).

Performance of the various elements used to control and select the Nimrod high-energy particle beams is described. In other discussion, numerical techniques used in beam handling are reported. A schematic of the Nimrod is included. Information is given on the quadrupole systems, velocity separation, and low-momentum K^- beams. (J.R.D.)

28223 (TID-7636(p.433-6)) SOME NEW ASPECTS IN BEAM TRANSPORT DEVELOPMENT. PART I. A FAST ANALOG COMPUTER FOR BEAM ENVELOPES AND PARTICLE TRAJECTORIES. W. Kern and K. G. Steffen (Deutsches Elektronen-Synchrotron, Hamburg).

Design and operation of a system based on analog computer methods for calculation of beam envelopes are described. A description of the computer is given along with a discussion of design improvements. (J.R.D.)

28224 (TID-7636(p.437-44)) SOME NEW ASPECTS IN BEAM TRANSPORT DEVELOPMENT. PART II. A QUADRUPOLE MAGNET WITH NON-CIRCULAR APERTURE AND LINEARIZED END FRINGING FIELD. K. G. Steffen (Deutsches Elektronen-Synchrotron, Hamburg).

A type of quadrupole magnet cross section is suggested and compared with the standard circular aperture. It is shown that a significant improvement of acceptance in phase space is gained by this design. A general investigation concerning acceptance of long periodic strong-focusing channels is used as an approach to optimizing standard quadrupole parameters. Special end-field configurations are suggested for quadrupole and for bending magnets. They eliminate to a large extent, the nonlinear aberrations which are generally caused by fringe fields. (J.R.D.)

28225 (TID-7636(p.445-51)) PRODUCTION OF A NANOSECOND MODULATED BREMSSTRAHLUNG BEAM BY THE INHERENT RADIOFREQUENCY BUNCHING OF THE ELECTRON SYNCHROTRON. R. L. Anderson, B. D. McDaniel, and A. Sadoff (Cornell Univ., Ithaca, N. Y.).

In designing an experiment to make improved measurements on K-meson photoproduction using an electron synchrotron, it was found desirable to make time-of-flight measurements through a magnetic spectrometer. A successful method was found in passing two signals into a diode ring modulator which generates a sine wave corresponding to the heat frequency; the phase is related in a simple way to the relative phases of the two input signals. Further development of this method produced a multichannel pulse-height analyzer system to measure the time from initiation to the point of the first negative-going zero of the ring modulator. (J.R.D.)

28226 (TID-7636(p.452-8)) DESIGN AND PERFORMANCE OF A 3.3 Bev/c SEPARATED ANTIPROTON BEAM. C. Baltay, E. C. Fowler, J. R. Sanford, J. Sandweiss (Yale Univ., New Haven), H. N. Brown, W. B. Fowler, and M. Webster (Brookhaven National Lab., Upton, N. Y.).

A high-energy high-purity antiproton beam was set up at the Brookhaven AGS for use with the 20 in. H bubble chamber in studying $\bar{p}$ + p reactions. Design descriptions and diagrams are given, and operational data and pictures are included. (J.R.D.)

28227 (TID-7636(p.459-67)) PRODUCTION OF SECONDARY BEAMS AT THE CERN PROTON SYNCHROTRON. H. Fischer and W. Richter (European Organization for Nuclear Research, Geneva).

General characteristics of the CERN synchrotron which determine the production of secondary beams are described. Included are descriptions of short burst production methods, long burst production, and beam dumping. (J.R.D.)

28228 (TID-7636(p.471-5)) SPACE-CHARGE EFFECTS IN ELECTRON-ELECTRON AND POSITRON-ELECTRON COLLIDING OR CROSSING BEAM RINGS. F. Amman and D. Ritson (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati).

Results are presented which apply to the case of electron-electron or electron-positron rings. These results show that if two beams collide, the less intense beam (A) will be stable in the presence of beam (B) up to some limiting effective density of beam B and will then break up into a diffuse halo around beam B. The calculations for the diffuse halo are made in the approximation that the field owing to a ribbon of charge is constant, except close to the ribbon plane, and changes sign as the plane is crossed. Cases considered include head-on collisions and crossing beams. (J.R.D.)

28229 (TID-7636(p.476-8)) SPIRAL-SECTOR FFAG MAGNETS. R. O. Haxby, R. S. Christian, G. del Castillo, and S. C. Snowdon (Midwestern Universities Research Assn., Madison, Wis.).

Design and model construction of spiral sector FFAG magnets are discussed. (J.R.D.)

28230 (TID-7636(p.479-86)) COMPUTER STUDIES AND EXPERIMENTAL MEASUREMENTS OF FIELD PERTURBATIONS IN THE MURA TWO-WAY ELECTRON ACCELERATOR. G. Parzen, C. H. Pruett, W. A. Wallenmeyer, and D. E. Young (Midwestern Universities Research Assn., Madison, Wis.).

Measurements of the MURA 40-Mev electron model (a radial-sector FFAG accelerator) are presented. Included are data and discussions concerning the unperturbed machine, the $\nu_r = 4.5$ resonance, the $\nu_z = 3$ resonance, the $\nu_r + \nu_z = 7$ resonance, and results of field perturbation measurements. (J.R.D.)

28231 (TID-16083) TWO-MILE ACCELERATOR PROJECT STATUS REPORT, JANUARY 1 TO MARCH 31, 1962. (Stanford Univ., Calif. Stanford Linear Accelerator Center). Apr. 1962. Contract AT(04-3)-363. 61p. (M-296)

Activities in a program to design and develop the Stanford 2-mile linear accelerator are reported. The project, now called the Stanford Linear Accelerator Center (SLAC), is scheduled for construction at an early date. Design and other associated information is given on the Mark IV program for orienting new SLAC personnel, accelerator structure and high-power waveguide components, the injection system, klystron studies, high power klystron windows, modulator studies, mechanical engineering, instrumentation and control, research area planning, and plant engineering. (J.R.D.)

28232 (UCRL-10122) BEVATRON OPERATION AND DEVELOPMENT. XXXI. [Period Covered], August–October 1961. Walter D. Hartsough (California. Univ., Berkeley. Lawrence Radiation Lab.). May 4, 1962. Contract W-7405-eng-48. 12p.

The Bevatron operated 80% of the scheduled operating time. The machine was off 18% of the scheduled operating time because of component failure and 2% at the request of the user. A total of 811 hours of experimental time was accumulated by four physics groups engaged in primary experiments; 254 hours were accumulated by outside groups. Four target bombardments were made. (auth)

28233 (JPRS-13752) SOVIET RESEARCH IN CYCLIC ACCELERATORS. Translated from Trudy Fiz. Inst., Akad. Nauk S.S.S.R., Fiz. Inst. im. P. N. Lebedeva, 13: 3-173(1960). 287p.

An investigation is made of the motion of particles in accelerators, mainly from the physical viewpoint. In addition, methods for controlling the effective values of all basic magnitudes entering into the phase equation are studied. Problems considered and evaluated include: linear and nonlinear theory of betatron oscillations in magnetic periodic systems, critical energy is strong-focusing synchrophasotrons, theory of electron motions in cyclic accelerators designed for high forces taking into account the effect of radiation, and theory of an annular synchrocyclotron with a constant field. Methods for securing an arbitrary dependence of the autophasing parameter upon the energy in accelerators with time-constant magnetic fields were found, as well as a method of controlling the accelerating field, during which the effective value of the amplitude of the accelerating voltage may be simultaneously different for particles with different masses and/or different charge signs. (N.W.R.)

28234 HIGH ENERGY ACCELERATORS. Atomics, 13, 12-21(1962).

The history of linear accelerators is outlined, and the characteristics of linear accelerators used to achieve high energies are described. Electron accelerators are discussed, and the use of the Cockcroft-Walton accelerator to produce neutrons by the D-T reaction is shown. (T.F.H.)

28235 NEW METHOD OF CONSTRUCTING A MULTILIMB MAGNET CORE OF A BETATRON. R. Breitenfeld. Elektrie, No. 4, 28-30(1961). (In English)

A construction method for multilimb magnet cores of round cross section is described without requiring mechanical treatment of the joining surfaces between the center limb and the short-circuit yoke. Transformer cores can be manufactured according to this method, too. A certain relation between induction in the exciting flux and the control field strength has to prevail in order to ensure the motion of electrons on the so-called nominal circle during the acceleration process. Deviations of electrons from the nominal circle occur by losses in the magnet core causing a phase shift of the control-field strength opposite to the field strength of the exciting current. In order to avoid the deviations mentioned, the magnet core has to be carefully and precisely manufactured. Such a core consists of one, two, or multilimb magnets; four or six short-circuit yokes are used mainly in multilimb designs, whereby the central limb should possibly be arranged in radial symmetric layers. These designs, however, show several disadvantages caused by their composite structure, by the connection of the short-circuit yokes to the round central limb, etc. The mechanical treatment of the joining points, for example, leads to the formation of fins and by this of short circuits, causing the afore-mentioned phase shifts. The construction method of multilimb magnet cores avoids the disadvantages of the mechanical treatment in the points of connection between central limb and yokes. The magnet core consists of an equally designed upper and lower part, connected by simple yokes. The upper respectively lower parts consist of a cylindrical central core composed of numerous sheet packs, and of the outer core. Each sheet pack is pressed and glued together into yokes or yoke parts by means of special devices. Using keys, the outer sheets of a six-limbed core of a yoke part are bent by 30°. The keys remain on the spot after pressing and serve for the attachment of the winding. The pressing together of upper and lower parts to the yokes is done by means of special screws. The round central core limb is connected to a correspondingly developed pole piece. The air gap between pole pieces can be decreased by shim plates. The air gap of the magnetic core for the exciting field can be increased in the axial direction by adjustment of the central core parts. The tuning of the exciting field with the control field is necessary. The core design avoids the disadvantages of manufacture and facilitates adjustment, repair, and assembly. A 20 Mv betatron of the described core design operates in the Physikalisch-Technisches Institute der Friedrich-Schiller-Universität in Jena (Physico-Technical Institute of the Friedrich-Schiller-University in Jena). (OTS)

28236 CHARACTERISTICS OF THE ION-SOURCE OF THE CALCUTTA 37-INCH CYCLOTRON. P. K. Dutt, A. P. Patro, B. Basu, and A. Chatterjee (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Phys., 36: 169-79(Apr. 1062). (In English)

Probe studies were made of the electron and total ion current output from the hot-cathode capillary-arc type ion source of the cyclotron. The gas used in the ion source was hydrogen, and the ion of interest for cyclotron acceleration was the proton. These studies were made with arc current, arc voltage, gas pressure, and magnetic field as variable parameters. (auth)

28237 SCATTERING RADIATION INVESTIGATION AT THE ROSSENDORF CYCLOTRON Y-120-1. H. Abel and W. Rossbander (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 5: 474-80(June 1962). (In German)

In the present article, after a brief description of the measurement methods, the results of scattering radiation studies at the Rossendorf cyclotron are reported. Errors in the utilization of neutron scintillators were indicated of some measurements in neutron fields of various energies. By utilization of the RBW factor 10 for fast neutrons, its contribution to the total dose output given in rem units was determined as greater than 10%. The thermal neutron

component, which developed by moderation of the fast neutrons, is less than 1%. The ratio of the components of fast neutrons and the γ radiation is always less dependent on the energy of the accelerated particle. Therefore, the routine radiation protection control can be limited to γ dose output measurements. If the ion beam is deflected from the circular orbit and led to a target chamber, deflector and dees are shown to be the principal radiation sources. (tr-auth)

28238 INTRODUCTION TO THE MODE OF OPERATION OF PARTICLE ACCELERATORS. G. Hartwig. Kerntechnik, 4: 225-8(June 1962). (In German)

In a brief introduction to the operation of particle accelerators the most important types of accelerators are described. The Van de Graaff generator and the cyclotron are used to explain the principles of linear and circular accelerators. The accelerators developed from these two accelerators are then briefly characterized. Their importance for basic studies in nuclear physics is shown. (auth)

28239 THE GERMAN ELECTRON SYNCHROTRON. E. Lohrmann (DESY, Hamburg). Kerntechnik, 4: 229-33 (June 1962). (In German)

A brief review is given of the problems and working principles of a high-energy accelerator currently being built in Hamburg. This machine will accelerate electrons to 6×10^9 ev. It will be used for research in elementary particle physics. After a discussion of the fundamental physical problems in this field, a technical description of the accelerator is given. The instrumentation used for conducting experiments with high-energy accelerators is also discussed. (auth)

28240 CONSTRUCTION OF THE KARLSRUHE RELATIVISTIC ISOCHRONOUS CYCLOTRON. A. Kuellmer (AEG-Forschungsinstitut, Frankfurt am Main). Kerntechnik, 4: 234-40(June 1962). (In German)

The construction of the relativistic isochronous cyclotron for 50-Mev deuterons, developed by AEG for Kernreaktor Bau- und Betriebsgesellschaft m.b.H., is described. The radiofrequency system, the vacuum chamber, and the ion sources are discussed in detail. (auth)

28241 CYCLOTRONS FOR RELATIVISTIC ENERGIES. W. Schwertfueher (Atominstitut der Osterreichischen Hochschulen, Wien, Ger.). Kerntechnik, 4: 241-6(June 1962). (In German)

A survey is made of all types of circular accelerators which are based on the cyclotron principle and are designed for relativistic energies. The synchrocyclotron, the AVF cyclotron, and the electron cyclotron are reviewed in detail, and their basic differences in dealing with the problems of relativistic increase of mass are discussed. (auth)

28242 TANDEM ACCELERATORS. P. H. Rose, A. J. Gale, and R. J. Connor (High Voltage Engineering Corp., Burlington, Mass.). Kerntechnik, 4: 246-50(June 1962). (In German)

The "tandem principle" allows double use to be made of the high voltage available in particle accelerators. This is effected by injecting a beam of positive ions through a gas channel. An additional electron is picked up by a small percentage of the neutral atoms generated. These negative ions are separated magnetically and injected into a double acceleration tube of which the central electrode carries high positive voltage. An additional gas channel is installed inside the high voltage electrode; the ions passing through lose all electrons and become positive. These ions can therefore be accelerated by the same voltage difference a second time since the negative pole of the high voltage source is connected to both ends of the double tube. With a voltage of 6 Mv, for example, protons of 12 Mev can be obtained. Since the energy spread of particles accelerated in Van de Graaff generators is only ±1 kev, the energy stability of the 12-Mev protons is 1:12,000 or better. (auth)

28243 THE DIMENSIONS OF ACCELERATING GAPS WITH THE MICROTRON. A. Paulin (J. Stefan Institut, Ljubljana, Yugoslavia). Nuclear Instr. & Methods, 15: 306-8(May 1962). (In German)

The length of accelerating gap is calculated at a given starting phase for the resonant electron. Using a thermal cathode the resonant conditions are satisfied by a gap length of 18 mm for the 511 kev (a = 3) and 12 mm for the 255 kev (a = 3) mode. (auth)

28244 STUDY OF CURRENT MONITORS FOR A LINEAR ELECTRON ACCELERATOR. R. Bergere, E. Delzenne, and A. Veyssiere (Centre d'Études Nucléaires, Saclay, France). Nuclear Instr. & Methods, 15: 327-54(May 1962). (In French)

It is shown that as a consequence of the particular time structure, and hence frequency structure, of an accelerated electron pulse as delivered by a linear accelerator, several types of current monitors can be considered. Some examples are ferrite-core intensity transformers, microwave detectors based on the cavity principle, and a loop antenna or horn tuned to 3 kMc or to some multiple frequency, say 9 kMc. Monitors used for non-centered or non-accelerated electrons are also examined. The latter enables a study to be made of the position of the injection pulse within the uhf pulse as well as the parasitic impulses from multipactors electrons. (auth)

28245 PRESENT TRENDS IN THE SCIENCE OF PARTICLE ACCELERATORS. H. Bruck (Commissariat à l'Énergie Atomique, Paris). Nucleus (Paris), No. 2, 115-30(Mar.-Apr. 1962). (In French)

After a brief commentary on the cryogenic linear accelerator, which is still in a preliminary stage of development, three large ensembles that have been more completely developed are discussed. The three are the spiral cyclotron, storage rings, and the high-energy proton synchrotron. (J.S.R.)

28246 PERFORMANCE OF STEAM JET TARGET FOR PRODUCING NUCLEAR REACTIONS. V. A. Gladyshev, L. N. Katsaurov, and A. N. Kuznetsov. Pribory i Tekh. Ekspt., 7: 20-2(1962). (In Russian)

An experiment showed that a steam jet is not subordinate to laws of gas dynamics. Empirical formulas were derived for describing steam jet distribution. The effective thickness of steam jet targets developed with a 1000 l/sec high-vacuum pumps is of the order of several hundreds of ev and can be used as a cyclotron target. Operations with ~1 cm^2 focused beam evolve a target of several kev. (R.V.J.)

28247 CYCLOTRON ADJUSTMENT FOR MULTI-CHARGED ION ACCELERATION. G. I. Indreash and Yu. Ts. Oganesyan (Joint Inst. of Nuclear Research, Dubna, USSR). Rev. phys., Acad. rép. populaire Roumaine, 6: 507-8(1961). (In Russian)

Acceleration of heavy ions in a 120-cm cyclotron ordinarily used with light particles was discussed previously. Experiments show that with small adjustments it is possible to accelerate ions with mass-charge ratios of $2 \leq A/Z \leq 3.7$ up to ~6 Mev/nucleons. A singly-charged molecule (DH) with weak deuterium-hydrogen binding energy was used in the experiment. Accelerated $(DH)^+$ ions, in reacting with matter, break up into protons and deuterons with identical velocities ($E_d = 2E_p$). Considering p and d velocities about identical, deuteron tracks exceed proton

tracks by a factor of 2. It is possible to adjust the apparatus for recording only deuteron beams, hence, the data on $(DH)^+$ acceleration can be obtained by studying deuteron beams by considering $E_d = \frac{2}{3}E_{(DH)}$. (R.V.J.)

28248 EXTENSION OF THE ENERGY RANGE OF U-120 TYPE CYCLOTRON. I. Teodorescku, M. Makovei, and V. Teodoru (Inst. of Nuclear Physics, Bucharest). Rev. phys., Acad. rép. populaire Roumaine, 6: 555-65 (1961). (In Russian)

A variable-energy adjustment of the U-120 type cyclotron was achieved by correcting the magnetic field radial configuration by means of central and peripheral shims. Magnetic field configurations are developed for various heavy ions. (R.V.J.)

28249 THE 15-MILLION ELECTRON-VOLT LIGHT-WEIGHT BETATRON. Hiroshi Kamogawa, Shun Sugimoto, Ikutaro Nagami, Hisaji Fukatsu, and Setsuo Nakamura (Tokyo Shibaura Electric Co., Ltd.). Toshiba Review, 60-6(Jan. 1960). (In English)

The principles followed in the design of the betatron are outlined. Operating experience with the betatron in various applications is discussed. The weight of the magnet head (excluding electronic circuitry, etc.), is 700 kg. (T.F.H.)

28250 MOTION OF A CHARGE THROUGH THE WAVEGUIDE PARTLY FILLED WITH THE DIELECTRIC. S. N. Stolarov (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 32: 541-8(May 1962). (In Russian)

The Cherenkov field charge passing parallel to the axis of a waveguide partially filled with a dielectric was analyzed. Approximations were developed for complete energy loss by the charge in passing in the proximity of a dielectric layer on the waveguide surface. Evaluations are made of the coherent losses in changed particle clusters. (tr-auth)

Plasma Physics and Thermonuclear Processes

28251 (AD-270136) A STUDY OF PLASMA INTERACTION WITH TRAVELING WAVES. Technical Report No. 408-1. S. F. Paik (Stanford Univ., Calif. Electron Devices Lab.). Oct. 31, 1961. Contract Nonr 225(24). 135p.

Properties of a transmission system consisting of a plasma column and a slow-wave circuit are investigated. The effect of the presence of plasma on the natural propagating mode of the circuit is investigated, including the second-order effects in plasma. A study of coupled modes of propagation involving a helix and a space-charge mode of the plasma column is presented. The experimental work carried out to measure the coupled modes of propagation is described. The parametric gain of a forward-wave amplifier using a helix as the traveling-wave circuit, is calculated using the measured values of circuit parameters. (auth)

28252 (AFOSR-3018) A NEW APPROACH TO TRANSPORT PROBLEMS IN FULLY IONIZED PLASMAS. [PART] II. S. F. Edwards (Manchester, England. Univ.; United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England), and J. J. Sanderson (Maryland. Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics). June 1962. Contract AF49(638)-401. 17p. (BN-293)

A general method is given for solving the equations governing the propagation of one and two particles through a fully ionized, near-equilibrium plasma. The coefficient of electrical conductivity is determined variationally with the exclusion and inclusion of plasma oscillation effects. Without plasma oscillations the result agrees within about 3% of previously determined values. The effect of plasma oscillations is small, the correction being about 0.4%. (auth)

28253 (ARL-62-334) INVESTIGATION OF THE DYNAMICS OF IONIZED MEDIA (PLASMA). Wesley E. Brittin (Physics, Engineering, Chemistry Corp., Boulder, Colo.). Apr. 1962. Contract AF 33(616)-7586. 179p.

A study was made of the methods of treating dilute plasmas. Emphasis was placed on fundamental rather than semi-empirical methods. Two approaches were investigated—one, that of Bogoliubov and the other, that of Prigogine and his coworkers. These two approaches led to the same results insofar as plasmas are concerned, but the Prigogine method seemed to be more general and capable of treating a wider class of problems. Also, the assumptions used by the Prigogine school appeared to be more directly justifiable. The report is essentially a detailed account of the Prigogine school's approach to non-equilibrium statistical mechanics. The starting point is the Liouville equation describing the motion of the entire system. The advantage of using the Liouville equation is that it is linear as contrasted to the non-linear equations of dynamics. The Liouville equation is solved (initial value problem) formally by means of the resolvent expansion technique. Terms in the expansion are associated with diagrams, which are then used to study properties of the terms. Classes of diagrams which are relevent to physical situations can in some cases be summed and lead to macroscopic equations of transport. The procedure is illustrated for weakly interacting systems. The long-range nature of the coulomb force is treated, and the Balescu equation for a homogeneous plasma is derived. (auth)

28254 (CEA-2121) COURBES DES INDICES DE PHASE ET DE GROUPE D'ONDES ELECTROMAGNETIQUES SE PROPAGEANT DANS UN MILIEU IONISE. (Phase and Group Refractive Index Curves for Electromagnetic Waves Moving in an Ionized Medium). T. Consoli (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1962. 42p.

A family of curves which give the phase and group refractive indexes of plane electromagnetic waves propagating along and across a static magnetic field in a plasma is presented. (auth)

28255 (NP-11787) PROGRESS REPORT NO. 21 [ON MICROWAVE RESEARCH] OCTOBER 1, 1961 THROUGH MARCH 31, 1962. Ernst Weber (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Contract AF18(600)-1505. 135p. (R-452.21-62)

Investigations in electromagnetics include work on non-conventional wave guides, and effects of large perturbing surfaces on electromagnetic fields. In plasma electrophysics and electronics, the interaction of high level microwave power with supersonic plasma shock is being investigated. Activities in solid state research are primarily concerned with the interaction of microwave fields with ferrite materials and semiconductors. Microwave research is concerned mostly with components and equipment to meet requirements beyond those encountered in the present microwave art. Lumped and distributed parameter networks and their application to design of devices with optimum terminal performance particularly in the microwave region are under study. Other development is reported in systems control. (J.R.D.)

28256 THE GENERAL SOLUTION OF THE INITIAL VALUE PROBLEM FOR LONGITUDINAL PLASMA OS-

CILLATIONS. R. S. Zelazny (Case Inst. of Tech., Cleveland). Ann. Phys. (N. Y.), 19: 177-85(Aug. 1962).

The general solution of the initial value problem for longitudinal plasma oscillations is found by means of a Fourier transform of the Boltzmann-Vlasov equation and by an eigenfunction expansion method developed by van Kampen and Case. The important feature of the solution presented here is that it gives the full Fourier component of the distribution function of electrons in a plasma. This is obtained without any integration with respect to some velocity components, as is generally done in all preceding papers on this problem. (auth)

28257 THE SELF-CONTAINMENT OF A PLASMA COLUMN IN ADIABATIC REGIME. Antonio Melis. Atti accad. sci. Torino. I. Classe sci. fis., mat. e nat., 96: 489-500(1961-62). (In Italian)

The containment of a completely ionized gas column in motion was studied using the hypothesis that the thermodynamic evolution is governed by a polytropic equation. It is assumed that the charged particles of the plasma in adiabatic regime, moving in the direction of the plasma motion with constant velocity, are distributed with cylindrical symmetry with respect to the axis. This means that the numerical density of the particles should be considered dependent only on the distance from the axis. (J.S.R.)

28258 ELECTROMAGNETIC WAVES IN A BOUNDED, ANISOTROPIC PLASMA. K. A. Graf and M. P. Bachynski (RCA Victor Research Labs., Montreal). Can. J. Phys., 40: 887-905(July 1962).

The interaction of a plane, electromagnetic wave with a flat, uniform, free-space–plasma interface in a static magnetic field is considered for arbitrary angles of incidence. The dispersion relation for the plasma is a complex quartic equation which reduces to a quadratic if the static magnetic field and plasma boundary are oriented along any one of the rectangular co-ordinate axes. (These axes need not simultaneously be the same for the plasma and the magnetic field.) Numerical results are presented for the attenuation and phase constants for each of the two possible waves in the plasma, for each orientation of the static magnetic field. Data are given for various angles of incidence, plasma properties, and orientations of the static magnetic field relative to the plasma boundary. Inspection of the fields in the plasma reveals some interesting aspects. In certain cases, waves which appear to move upward toward the plasma interface exist. Since these waves may carry energy into the plasma, they were referred to as "backward" waves. Totally reflected waves that have both finite attenuation and finite phase coefficients can also exist in the plasma. (auth)

28259 REACTIONS PRODUCED BY THE PASSAGE OF A BEAM OF MOLECULAR HYDROGEN IONS ACROSS AN IONIZED MEDIUM. Joseph Guidini, André Jeudon, Claude Manus, and Théodore Sinda. Compt. rend., 254: 3081-3(Apr. 25, 1962). (In French)

A method permitting the measurement of the dissociation and ionization cross sections of H_2 ions crossing an ionized medium is presented. The first results show that the values for these cross sections are higher than the corresponding cross sections for collisions of neutral particles. (tr-auth)

28260 A DISPERSION RELATIONSHIP IN THE THEORY OF NON-LINEAR LONGITUDINAL OSCILLATIONS OF A RELATIVISTIC PLASMA. Mircea Draganu. Compt. rend., 254: 3508-10(May 14, 1962). (In French)

A coherent theory of nonlinear oscillations of a completely ionized plasma having a state of rarefaction sufficiently high to neglect shock effects was developed using the nonrelativistic Boltzmann equation. This theory was extended to the case of relativistic plasma by using the relativistic Boltzmann equation. A nonlinear dispersion relation was derived for the electric charge waves of a plasma, assuming only two components. It was also assumed that all oscillating variables in the problem depend only on the linear combination $x - Vt$, V being the constant propagation velocity of the charge wave. (J.S.R.)

28261 DAMPING OF TURBULENCE. FINAL STAGE. ENERGY SPECTRA. Pierre Lecocq (Électricité de France, Paris). Compt. rend., 254: 3633-5(May 21, 1962). (In French)

The termination of the damping of the homogeneous turbulence of an incompressible conducting fluid in the presence of a transverse magnetic field is examined. The evolution of the spectra with time for a constant Hartman number and the effect of the Hartman number on the damping are shown graphically. (J.S.R.)

28262 A CRITIQUE OF LANDAU ABSORPTION. Carl F. Wandel and Vagn O. Jensen (Centre de Recherches, Risö, Denmark). Compt. rend., 254: 4156-7(June 13, 1962). (In French)

A recently announced criticism of the Landau absorption is rejected. (tr-auth)

28263 REMARKS ON THE LANDAU ABSORPTION OF PLASMA OSCILLATIONS. Jean-Francois Denisse and Donald McLean (Observatoire de Paris). Compt. rend., 254: 4158-9(June 13, 1962).

Certain criticisms formulated in a preceding note (Compt. rend., 253: 1539(1961)) on Landau absorption and on the linear approximation in the study of plasma oscillations are specified. (tr-auth)

28264 NEW METHOD FOR THE MEASUREMENT OF THE VARIATIONS OF THE ELECTRON DENSITY OF A PLASMA AS A FUNCTION OF TIME. Roger der Agobian. Compt. rend., 254: 4269-71(June 18, 1962). (In French)

It is known that the creation of a plasma at the interior of a hyperfrequency cavity produces a dephasing Δf proportional within certain limits to the electron density $\underline{n}$. The utilization of a hyperfrequency discriminator has permitted an amplitude signal to be obtained which is proportional to Δf and to $\underline{n}$, and therefore permitted the recording of $\underline{n}(t)$ to be effected on a single discharge. The experimental setup is shown schematically, and the experimental techniques are briefly summarized. (J.S.R.)

28265 THE PROPAGATION OF ULTRASONICS IN A PLASMA. Maurice Surdin. Compt. rend., 255: 82-4 (July 2, 1962). (In French)

By means of simplifying the hypotheses, the equation for the propagation of a sound wave in a plasma is obtained. The attenuation of ultrasonic waves is given for the case of not very dense plasmas at low pressure. (tr-auth)

28266 TAYLOR INSTABILITY OF AN INCOMPRESSIBLE PLASMA UNDER A VARIABLE ACCELERATION. John Jarem (Univ. of Pennsylvania, Philadelphia). Dissertation Abstr., 22: 1216-17(Oct. 1961).

A theoretical analysis is made of the stability of an interface between dissimilar, incompressible, ionized gases undergoing variable acceleration. This study represents a generalization of a study of Taylor instability of fluid and plasma interfaces and of the fluting instability. The cases investigated include plane, cylindrical, and spherical plasma configurations confined by a magnetic field. A perturbation analysis of the unperturbed accelerated plasma motion yields differential equations with time-dependent coefficients for the growth behavior of disturb-

aces at the interface. For accelerations that do not change sign the results are similar to the conventional analysis for surfaces at rest, although interface radial dimensions and velocities lead to modified stability criteria. A possibility for stabilizing an otherwise unstable surface arises as a result of applying oscillatory driving forces. The effect is physically similar to that of stabilizing an inverted pendulum by oscillating its support, or to the stabilization scheme used in alternating-gradient accelerators. For the case of a plane undergoing oscillatory motion and supported against gravity, the stability conditions are described by the Mathieu equation. For other prescribed motions, stability criteria based on analytic and numerical solutions of the interface stability equations are presented for the three geometries and for a range of plasma parameters.

28267 THE LINES OF FORCE OF A MAGNETIC FIELD. V. K. Mel'nikov (United Inst. of Nuclear Studies, USSR). Doklady Akad. Nauk S.S.S.R., 144: 747-50(June 1, 1962). (In Russian)

The motion of a plasma in a given magnetic field can be studied by finding the force lines of the field. The boundary separating two regions with a different behavior of the force lines is very complex in form, and this complexity is one of the reasons for the appearance of protuberances in the plasma that lead to instability of the plasma. A magnetic field without vortices is considered and described by the scalar potential $H_0 z + \chi(x,y,z)$, where H_0 is constant, and $\chi(x,y,z)$ is a periodic function with respect to z that satisfies the Laplace equation. The differential equations for the force lines of field are written, and the distribution for the trajectories in the system are shown graphically. The equations are also written for a three-turn, spiral magnetic field. Stable and unstable force lines can exist depending on the choice of parameters. The choice of the magnetic field used to contain the plasma can substantially increase the life-time of the plasma. (TTT)

28268 STUDY OF THE MOTION OF A CHARGED PARTICLE IN A ROTOTRON CONSIDERING THE ELECTRIC FIELD ASSOCIATED WITH THE MAGNETIC FIELD. M. Puglisi and G. Sacerdoti (Comitato Nazionale Energia Nucleare, Ispra, Italy). Elettrotecnica, 48: 1-7(1961). (RT/FI(62)8). (In Italian)

Formulas for the motion of a charged particle in the field of a rototron are derived. The electric field, expressly taken into account, changes radically the results obtained taking into account only the magnetic field. It is seen that when the rotation frequency is equal to the cyclotron frequency of the particle divided by the square root of two, confinement of the particle, whatever its initial conditions may be, is obtained. Apart from technical difficulties, it is therefore possible to realize a device that is able to confine a non-relativistic plasma so rarefied that the perturbation introduced in the guide field by the particles can be neglected. (auth)

28269 CHARACTERISTICS OF ARGON PLASMA BEAM GENERATORS FOR SUBSONIC VELOCITY. W. Neumann (Deutschen Akademie der Wissenschaften, Berlin). Exptl. Tech. Physik, 10: 124-40(1962). (In German)

The plasma beam output as a study of research parameters was determined for three different types of plasma beam generators operating with argon, and its regularity was established. The plasma beam temperature was determined spectroscopically from the continuous radiation of the plasma beam near the beam outlet. Together with the measurement values for the enthalpy increase of the gas by its heating in the electric arc and with the measurement values for the plasma beam diameter, the current velocity $\underline{v}$ of the plasma beam could be determined. In conclusion, a formula was given with which the heating of small particles, which were transported with the plasma beam over a given length, could be calculated. An example calculation was shown. (tr-auth)

28270 HYDROMAGNETIC WAVES IN A CYLINDRICAL PLASMA: AN EXPERIMENT. D. F. Jephcott and P. M. Stocker (Culham Lab., Berkshire, Eng.). J. Fluid Mech., 13: 587-96(Aug. 1962).

In a previous paper (Woods 1962) a theory is presented which leads to a general dispersion relation for hydromagnetic waves in a dissipative plasma contained in a cylindrical tube. Experimental observations are compared with the predictions of this theory. An experiment is described in which torsional hydromagnetic waves are excited in a gas discharge. Measurements of the wave velocity and damping are compared with the solutions of the dispersion equation which are computed from measured values of the plasma parameters. The results are consistent with the theory, and good numerical agreement is obtained by assuming a loss of particles to the tube walls. There is evidence of a cut-off in wave propagation in the region of ion cyclotron resonance. (auth)

28271 PLASMA AS A PROPELLANT FOR SPACE TRAVEL. F. Ferrie (Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris). Luftfahrttechnik, 7: No. 7, 205-12(1961). (In German)

Chemical rocket motors have limited possibilities for space travel problems. Ionic and plasma motors are promising in this regard. The working principle of the plasma motor depends on the acceleration of the plasma in electric and magnetic fields as well as possible contraction of the plasma radiation. From the numerous kinds of plasma motors, the magnetohydrodynamic motor appears especially promising. Sun energy, nuclear energy, or the magnetohydrodynamic generator under consideration serve as energy sources. With respect to the adjustment of the plasma motor on the charging problem and energy source, propulsion with a hydrodynamic flywheel is shown to be very useful. (tr-auth)

28272 DIRECT CONVERSION OF NUCLEAR ENERGY INTO ELECTRICAL OR THRUST ENERGY. Karl M. Fuechsel. Nuclear Energy, 306-12(Aug. 1962).

Direct conversion of nuclear energy into electrical energy or thrust involves the confinement of a plasma at temperatures of the order of 10^8 °K and higher, which excludes physical walls. Two concepts through which this may be done are introduced. In both cases spherical waves propagate radially inward. In the first, the amplitude is the electric field strength and in the second it is the number, or mass, or total charge of the oscillating electrons. In both cases the plasma electrons are forced to execute radial oscillations, which are superimposed on their random oscillations by the action of the waves. The time-average current of the oscillating electrons in the second concept and the minimum amplitude of the electric field for plasma confinement in the first are calculated. Nuclear energy can be converted directly into electrical energy or thrust in complete cycles. The engine used for this can be converted to a vacuum pump when used without load. When used in space the engine operates at temperatures of glowing metal, which is favorable for radiation cooling, the only possible method for sustained operation. There are no gyromagnetic radiation losses because there is no static magnetic field. The magnetic flux density resulting from the displacement current of the

oscillating electrons in the second concept exceeds known values and may facilitate new findings. (auth)

28273 ON THE RELATIVISTIC DEGENERATE ELECTRON GAS. B. Jancovici (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nuovo cimento (10), 25: 428-55(July 16, 1962). (In English)

The properties of a relativistic, degenerate, high-density, zero-temperature electron gas in a uniform positive background are studied, in the dielectric formulation of the quasi-boson approximation. The hamiltonians associated with the quasi-boson approximation are described and diagonalized, and the momentum- and frequency-dependent longitudinal and transverse dielectric constants are defined and computed. Calculations are made of the Coulomb field screening, dispersion laws for transverse and longitudinal wave propagation, and ground state energy of the gas. (T.F.H.)

28274 SCATTERING OF ELECTROMAGNETIC WAVES BY A NONEQUILIBRIUM PLASMA. M. N. Rosenbluth and N. Rostoker (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 5: 776-88(July 1962). (GA-2946)

Incoherent scattering is determined by the spectral density of electron-density fluctuations. This quantity is calculated for spatially homogeneous nonequilibrium states of a hot plasma. An elementary derivation of the results is given in terms of dressed test particles. Numerical calculations are carried out for a plasma with hot electrons and cold ions, and for a plasma in which the electrons have a net drift relative to the ions. (auth)

28275 HIGHLY IONIZED, STEADY-STATE PLASMA SYSTEM. Laurence S. Hall and Andrew L. Gardner (Univ. of California, Livermore). Phys. Fluids, 5: 788-94(July 1962).

A system is described that produces a steady-state helium plasma with greater than 95% ionization. The primary plasma is generated in a modified Phillips ion gauge discharge and diffuses along a magnetic field (B ~ 1 kG) through a region in which neutral particles are preferentially removed. In the downstream region a plasma density of $\sim 2 \times 10^{13}$ cm^{-3} and ion temperatures up to 10 ev may be achieved. The over-all physical assembly, the operating characteristics of the system, and the nature of the plasma that is produced are described. In addition, a discussion of processes believed important in its operation is given. (auth)

28276 DIAGNOSTIC MEASUREMENTS ON A HIGHLY IONIZED, STEADY-STATE PLASMA. Andrew L. Gardner, William L. Barr, Raymond L. Kelly, and Norman L. Oleson (Univ. of California, Livermore). Phys. Fluids, 5: 794-802(July 1962).

Techniques and results are given for various measurements made on a highly ionized helium plasma in a steady-state plasma system (which employs a longitudinal magnetic field of approximately 1 kOe). Neutral-particle pressures range from about 3×10^{-4} mm Hg near the source to about 10^{-5} mm Hg in the downstream region. Spectroscopic measurements show principal impurities are C, N, and O ions (up to C^{3+}, N^{4+}, and O^{4+} states). Doppler broadening measurements of the He^{+} 4686 Å line reveal ion temperatures up to 10 ev. Probe measurements indicate electron temperatures up to 20 ev and maximum ion densities of a little over 10^{13} cm^{-3}. Microwave transmission measurements (at $\lambda = 4$ and 8 mm) give supporting evidence that the electron density exceeds 10^{13} cm. (auth)

28277 FREQUENCY DEPENDENCE OF PLASMA ACCELERATION BY RADIO-FREQUENCY FIELD GRADIENT. G. A. Swartz (RCA Labs., Princeton, N. J.) and T. Todd Reboul. Phys. Fluids, 5: 803-6(July 1962).

Plasma acceleration by an r-f field gradient is observed for both 140 and 330 Mc fields. The kinetic-energy gain of the accelerated ions varys inversely with the applied frequency. Comparison with theory indicates that in the interaction region most of the accelerated plasma has a resonant frequency near the applied frequency. The collision frequency that limits the acceleration in the test apparatus is calculated to be 6 Mc. (auth)

28278 EQUILIBRIUM SOLUTIONS OF A PLANE ELECTRON BEAM IN A PLASMA. Thomas S. Lundgren (Univ. of Minnesota, Minneapolis) and Chieh-chien Chang (Aerospace Corp., El Segundo, Calif.). Phys. Fluids, 5: 807-14(July 1962).

Equilibrium solutions of an electron beam injected into a plasma are considered. This is a preliminary step in studying the stability of the so-called "E layer" of the Astron thermonuclear reactor. The model consists of a plane sheet of streaming electrons in a homogeneous plasma. Equilibrium solutions are obtained from the collisionless Boltzmann equations for three fluids; one of stream electrons; another of plasma electrons; and a third of plasma ions. Two important cases are treated in this manner, viz., cold plasma and cold beam. The distribution of beam electrons, plasma ions, and plasma electrons are disclosed. (auth)

28279 HYDROMAGNETIC STABILITY OF TOROIDAL EQUILIBRIA WITH AN EXTERNALLY IMPOSED ROTATIONAL TRANSFORM. John L. Johnson, John M. Greene, and Katherine E. Weimer (Plasma Physics Lab., Princeton, N. J.). Phys. Fluids, 5: 815-16(July 1962). (MATT-116)

A simple "single-term" stability criterion is obtained for hydromagnetic equilibria with multipolar fields. It replaces criterion in which it is necessary to evaluate the ratio of two infinite determinants. It corresponds to a criterion developed for arbitrary equilibria, but is tailored to a specific geometry. (auth)

28280 MEASUREMENTS ON THE FAST HYDROMAGNETIC WAVE ABOVE THE ION CYCLOTRON FREQUENCY. W. M. Hooke, M. A. Rothman, P. Avivi, and J. Adam (Princeton Univ., N. J.). Phys. Fluids, 5: 864-5(July 1962). (MATT-112)

The propagation of the fast hydromagnetic wave in a cylindrical plasma is studied. A driving signal having a frequency $\omega/2\pi = 16$ Mc is provided by means of an induction coil wrapped around the center of the plasma device. The ion cyclotron frequency ($\Omega_i/2\pi$) in the plasma is varied by varying the axial magnetic field intensity, and the experimental conditions are adjusted so that always $\omega > \Omega_i$. The phase shift between the applied signal and the plasma excitation signal is measured as a function of the axial distance from the exciting coil. The experimental results are compared with the predictions of the dispersion relations for $\omega/\Omega_i = 3.3$ and 12. (T.F.H.)

28281 EXPERIMENTAL OBSERVATIONS OF COLLIDING PLASMAS IN CUSPED AND MIRROR-GEOMETRY MAGNETIC FIELDS. J. N. Di Marco and W. H. Bostick (Stevens Inst. of Tech., Hoboken, N. J.). Phys. Fluids, 5: 866-7(July 1962).

A pair of solenoidal magnets is arranged coaxially so as to produce either a mirror or a cusp field. Plasmas are produced at both ends of the apparatus by means of plasma guns, and are directed axially toward the median

plane of the magnetic field, where they collide. An apparently turbulent interaction between the two colliding streams is observed; the plasma in the region of the interaction is found to be diamagnetic. (T.F.H.)

28282 REMARKS ON MAGNETOACOUSTIC WAVES. Wulf B. Kunkel (Univ. of California, Berkeley). Phys. Fluids, 5: 867-8(July 1962). (UCRL-10161)

Starting from the linearized magnetohydrodynamic equations for a dissipationless fluid, the relation between the polarizations of the fast and slow magnetoacoustic waves is investigated. Assuming the waves to be propagated along a direction at an angle Θ with respect to the magnetic field $H(= B/\mu)$, and the local velocity disturbances in the medium to be at an angle ϕ with H, a plot is shown giving ϕ as a function of Θ for various values of the parameter $\gamma = \mu\rho\underline{a}^2/B^2$) for both the fast and slow waves. $\underline{a}$ is the velocity of sound in the medium and ρ is the density of the medium. (T.F.H.)

28283 TRANSPARENCY OF A DENSE PLASMA TO CIRCULARLY POLARIZED WAVES. T. Consoli, L. Dupas, and G. Ichtchenko (Service de Physique Appliquée, Gif-sur-Ivette, France). Phys. Letters, 1: 267-9(July 1, 1962). (In French)

A neutral gas in a magnetic field of 0 to 2 kOe receives a magnetic field pulse having an amplitude up to 21 kOe (parallel or antiparallel to the steady field) and a rise time and duration of 18 and 150 μsec respectively. The pulsed field produces plasmas with electron densities up to $5 \times 10^{15}/cm^3$. The plasma is found to be opaque to 1.2-mm waves transverse to the discharge, and transparent to 8.6-mm waves longitudinal with respect to the discharge. The waves may be polarized circularly (right- or left-handed). The results are discussed on theoretical grounds. (T.F.H.)

28284 STREAMERS IN THE NITROGEN PINCH. F. L. Curzon, R. J. Churchill, and R. Howard (Univ. of British Columbia, Vancouver, Canada). Phys. Letters, 1: 301-3(July 15, 1962). (In English)

Streamers are formed during the collapse stage of the linear pinch discharge in gases at 1 to 100 μ Hg. The linear z-pinch discharge is photographed at right angles to the tube axis by a synchronized framing camera permitting 60 pictures of each discharge to be taken. Results are given in graphical and tabular forms. (L.N.N.)

28285 THE ENERGY AND THE DIRAC DENSITY MATRIX OF A NON-UNIFORM ELECTRON GAS. W. Jones, N. H. March, and S. Sampanthar (Univ. of Sheffield, Eng.). Phys. Letters 1: 303-4(July 15, 1962). (In English)

Dirac's density matrix is found in a self-consistent framework. The problem of electrons moving in a periodic lattice of protons is considered, and difficulties of introducing Hartree fields associated with inner electrons are circumvented. For the conduction electrons, a Hartree description is adopted essentially. Physical significance of the results is enhanced by including screening from the outset. (L.N.N.)

28286 EXPERIMENTAL OBSERVATION OF PLASMA ELECTRON PRESSURE. I. Alexeff and R. V. Neidigh (Oak Ridge National Lab., Tenn.). Phys. Rev., 127: 1-3(July 1, 1962).

In a magnetically supported plasma column, the mechanical force parallel to the magnetic field exerted on an electrically floating balance was measured at 2 to 40 dynes. This measured force agrees with the force computed from the experimentally-measured plasma electron density and the electron temperature. The large range of agreement between this measured force and the computed force implies that in this apparatus, at least, the plasma pressure is due to the electrons and it can be measured directly. (auth)

28287 ELECTROMAGNETIC PROPERTIES OF A PLASMA-BEAM SYSTEM. Jacob Neufeld (Oak Ridge National Lab., Tenn.). Phys. Rev., 127: 346-59(July 15, 1962).

There are two electromagnetic modes in a plasma-beam system: the unstable "hybrid" mode characterized by the occurrence of a longitudinal component of the electric intensity E, and the transverse mode which does not show an instability and is characterized by the occurrence of a longitudinal component of the magnetic induction B. The behavior of this system is described in terms of macroscopic quantities such as the electric displacement D and the magnetic intensity H. The unstable hybrid mode in a plasma-beam medium is compared to related hybrid instabilities produced by a beam in a medium comprising harmonic oscillators. It is thus shown that the hybrid instability produced in a plasma is of type "1," as defined in Part I. Applying the appropriate criterion, it is found that the hybrid instability and the associated longitudinal instability are convective for $\theta \neq 0$, where θ is the angle formed by the direction of the beam and the direction of the growing waves resulting from these instabilities. For θ approaching $\pi/2$ the instability produced by the beam becomes aperiodic. The plasma-beam system is electromagnetically anisotropic and its anisotropy is investigated with reference to transverse and hybrid waves. For transverse waves the anisotropy is described in terms of a dependence between ϕ and θ, where ϕ is the angle formed by the vectors H and B. For hybrid waves the anisotropy is investigated in the "region of transparency" and in the "region of instability." In the region of transparency there is a dependence between ψ and θ, where ψ is the angle formed by the vectors D and E. In the region of instability there is a similar angular dependence and also a phase difference between the longitudinal and transverse components of the electric intensity E. Some of the effects produced by a beam in a thermal plasma are investigated in hydrodynamic representation. A formal analogy is established between the Vavilov-Cherenkov effect produced by a single particle passing through a thermal plasma and the longitudinal instability produced by a beam having the same velocity as the particle. This analogy does not apply to hybrid waves. (auth)

28288 THE HYDROMAGNETIC STABILITY OF THE HARDCORE PINCH WITH SMALL ELECTRICAL CONDUCTIVITY. R. J. Bickerton and I. J. Spalding (Culham Lab., Nr. Abingdon, Berks, Eng.). Plasma Phys.-Accelerators-Thermonuclear Research, J. Nuclear Energy, Pt. C., 4: 151-8(June 1962).

The hydromagnetic stability of a simplified hardcore system is examined in the limit of very small electrical conductivity. It is shown that instabilities develop as a result of the rapid penetration of magnetic field into the plasma, and their growth rates are calculated. A model experiment using liquid mercury is carried out and the results are compared with theory. Agreement is obtained when the latter is modified to include the effect of surface tension. (auth)

28289 NON-MAGNETOHYDRODYNAMIC INSTABILITIES OF PLASMA WITH HIGH CURRENT DENSITY. P. H. Rebut (Euratom-CEA, Fontenay-aux-Roses (Seine), France. Plasma Phys.-Accelerators-Thermonuclear Research, J. Nuclear Energy, Pt. C, 4: 159-68(June 1962). (In French)

The possible states of an isotropic plasma within per-

fectly conducting cylindrical walls are found. The study of isotropic plasma by the Boltzmann equations, neglecting certain collision terms, enables a complete set of macroscopic equations for equilibria to be obtained. These equilibria have helicoidal or cylindrical symmetry. With a perfectly conducting wall cylindrical equilibrium always exists. The existence of one or more helicoidal equilibria, which may be considered as distortions of the cylindrical state, is also possible. These various equilibria cannot all be stable. It can be shown that the first branch point of cylindrical and helicoidal equilibria gives a limit to the stability for the cylindrical equilibria with respect to the perturbations, which enables a passage to be made from one equilibrium to another. The calculations performed and the corresponding results are similar to buckling calculations in mechanics. The first buckling limit or branch point is obtained for the helicoidal mode m = 1, the distortion pitch being equal to the current pitch. The stability of the cylindrical state decreases with the increase of plasma current densities. This buckling occurs whatever the type of configuration, "pinch" or "unpinch," contrary to studies of magnetohydrodynamic stability. A numerical calculation made on the unpinch type of configuration shows which parameters influence the stability. (auth)

28290 THE EFFECTS OF A RADIAL VARIATION OF RESISTIVITY ON THE ATTENUATION OF A HYDROMAGNETIC WAVE IN A CYLINDRICAL PLASMA. L. C. Woods (Balliol Coll., Oxford). Plasma Phys.-Accelerators-Thermonuclear Research, J. Nuclear Energy, Pt. C, 4: 169-73(June 1962).

Hydromagnetic waves along cylindrical tubes are damped by electrical resistivity, η. The case is studied in which η is not uniform, but is a prescribed function of radius. The ionization is also permitted to vary across the cylinder. It is found that it is not sufficient to replace the uniform value of η by a suitably averaged value, and an example is given to show that for a particular case for which η at the tube wall is double its value at the center, such a procedure leads to an error of over 20 per cent in the resistive damping. Although radial variations in η can reduce the damping, it seems unlikely that this reduction is sufficient to produce instabilities in hydromagnetic waves. (auth)

28291 FIELD DIFFUSION IN CYLINDRICAL PLASMAS. J. A. Wesson (A.E.I. Research Lab., Aldermaston, Berks, Eng.). Plasma Phys.-Accelerators-Thermonuclear Research, J. Nuclear Energy, Pt. C, 4: 175-9(June 1962).

The diffusion of axial and azimuthal electric fields into an infinite cylindrical plasma is calculated for a constant applied electric, allowing for the effect of an external inductive space. Cases of constant conductivity and conductivity increasing exponentially in time are considered. (auth)

28292 AN EXPERIMENTAL AND NUMERICAL STUDY OF RADIAL HYDROMAGNETIC OSCILLATIONS. D. L. Fisher, T. S. Green, and G. B. F. Niblett (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Plasma Phys.-Accelerators-Thermonuclear Research, J. Nuclear Energy, Pt. C, 4: 181-4(June 1962).

A model is considered in which a cylindrical plasma compressed by a fast-rising axial magnetic field (B_z) undergoes hydromagnetic oscillations with a period $T = 2\pi\sqrt{M/B^2}$, where M is the mass of trapped gas per unit length. In the model the plasma is assumed to be trapped in a thin annulus, and the oscillations are assumed to be caused by oscillations of the plasma particles between the outer trapping field and the inner trapped field. Measurements are made on He and D_2 plasmas at pressures of 20 to 170 μ. The measured values of T indicate that essentially all the gas is trapped in the implosion of the plasma. By analysis of the oscillations, studies may be conducted of plasma temperatures and ionizations as functions of radial position in the plasma at a given time, and of time variations of B_z and dB_z/dt at the axis. The values of B_z and dB/dt calculated by this method for D_2 at 45μ are compared with computer calculations of the same parameters obtained by numerical solution of the hydromagnetic equations assuming a fully ionized gas. (T.F.H.)

28293 ON THE STABILITY CONDITIONS OF MAGNETOHYDRODYNAMIC CONFIGURATIONS AT EQUILIBRIUM. K. N. Stepanov and V. V. Khomenyok. Priklad. Mat. i Mekhan., 26: 466-70(May-June 1962). (In Russian)

Several theorems are presented determining the conditions of stability for an ideally conducting fluid. Necessary and sufficient conditions for stability closely related to a certain criterion of the energy principle for hydromagnetic stability are given. (TTT)

28294 SOLUTION OF SOME MAGNETO-HYDRODYNAMIC PROBLEMS WITH ANISOTROPIC CONDUCTIVITY. G. A. Lyubimov. Priklad. Mat. i Mekhan., 26: 530-41(May-June 1962). (In Russian)

Under certain conditions a generalization of Ohm's law leads to a vector equation describing a varying magnetic field, independent of the equations of mechanics. If the parameters in the problem are independent of one of the coordinates, the equation reduces to a system of two scalar equations. Properties of some solutions of this system are given. In the case of small currents and large applied magnetic fields, when in first approximation one can neglect induced fields, the solution can be expressed as a series of the small parameter $\lambda = 4\pi I/H_0 C$. As an example, the problem of the effect of an anisotropic conductivity on the flow of gas in a canal with crossed electric and magnetic fields, is treated. (TTT)

28295 INTERACTION OF A MODULATED ELECTRON BEAM WITH A PLASMA. G. D. Boyd, R. W. Gould, and L. M. Field (California Inst. of Technology, Pasadena). (Proc. I.R.E. (Inst. Radio Engrs.), 49: 1906-16(Dec. 1961).

The results of a theoretical and experimental investigation of the high-frequency interaction of an electron beam with a plasma are reported. An electron beam, modulated at a microwave frequency, passes through a uniform region of a mercury arc discharge after which it is demodulated. Exponentially growing wave amplification along the electron beam is experimentally observed for the first time at a microwave frequency equal to the plasma frequency. Approximate theories of the effects of plasma-electron collision frequencies; plasma-electron thermal velocities; and finite beam diameter are given. The interaction between a modulated electron beam and a slow electrostatic wave on a plasma column is also studied. A strong interaction occurs when the velocity of the electron beam is approximately equal to the velocity of the wave, and the interaction is essentially the same as that which occurs in traveling-wave amplifiers, except that the plasma column replaces the helical slow-wave circuit. The theory predicting rates of growth is presented and compared with the experimental results. (auth)

28296 ION OSCILLATIONS IN MULTISTREAM PLASMAS. E. R. Harrison (Rutherford High Energy Lab., Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 80: 432-40 (Aug. 1, 1962).

Longitudinal ion oscillations (including ion–ion oscillations) in two-stream and multistream plasmas are discussed, using first the fluid equations and then the Vlasov

equations. Ion oscillations occur when the electron inertia is small compared with the electron pressure (i.e., when the magnitude of the phase velocity of the wave relative to the electrons is less than the electron thermal speed). The fluid approach to the subject fails to treat in an adequate way the damping effect of the ion thermal motions and therefore cannot provide precise criteria for stability. Furthermore, in a collision-free plasma it is not clear from the fluid treatment whether the electrons fluctuate isothermally or adiabatically, and to this extent there is some doubt whether ion oscillations are possible in the absence of electron–electron collisions. On the assumption that collisions are of negligible effect, the Vlasov equations are then used to derive an ion oscillation dispersion relation in which, for wavelengths greater than the electron Debye length, the ion plasma frequencies are reduced by the screening effect of the electrons. This equation shows that the electron gas fluctuates isothermally and the electron density therefore varies according to the Boltzmann law. The stability of ion–ion oscillations in multistream plasmas is then considered. It is shown, for example, that the sufficient condition for stability for all possible velocities of the ion streams is that $(\overline{T_j^{-4}})^{-1}/T_e \geq 0.2847$, where T_e is the electron temperature and $(\overline{T_j^{-1}})$ is the mean reciprocal of the ion temperatures. This result is for singly-charged ions and is readily generalized for multiply-charged ions. When the multistream medium consists of two identical counterstreaming plasmas the condition that there are no exponentially time-growing ion oscillations is determined in terms of the plasma velocities. (auth)

28297 ALFVÉN WAVES. Forrest I. Boley and John M. Wilcox (Univ. of California, Berkeley). Science, 137: 511-14(Aug. 17, 1962).

In 1942 the Swedish astrophysicist Hannes Alfvén postulated the existence of a new kind of wave motion in an attempt to explain certain sunspot phenomena. An impressive demonstration of Alfvén waves was produced in 1958 by the explosion of a nuclear device in the earth's ionosphere. A new field of study called magnetohydrodynamics, or hydromagnetics, has developed to study the relationship between conducting fluids and magnetic fields. A set of laboratory experiments is described that establish the primary properties of Alfvén waves. Natural phenomena in which these waves exert a strong influence are discussed. (C.H.)

28298 VACUUM PHYSICS AND TECHNOLOGY IN THERMONUCLEAR RESEARCH IN GENERAL AND IN THE STELLARATOR PROGRAM. G. Lewin (Princeton Univ., N. J.). Vide, 17: 120-33(1962). (In English and French)

A brief survey is made of the operating conditions of thermonuclear reactors and plasma containment and heating as an introduction to a discussion of the role of vacuum physics and technology in thermonuclear research. The stellarator principle is described, and design requirements for stellarator vacuum systems are given. The "C" stellerator is described. (J.S.R.)

28299 MAGNETIC FIELD WITHIN A CONDUCTING INTERSECTED CYLINDRICAL CHAMBER WITH CUTS. L. M. Kovrizhnykh (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 32: 517-25(May 1962). (In Russian)

The perturbations inside a conducting, cylindrical chamber, with cuts across its axis, in a periodically varying longitudinal or helical magnetic field were determined for the case in which the boundary layer is much thicker than the wall of the cylinder. (tr-auth)

28300 THE INFLUENCE OF PERTURBATIONS ON THE STRUCTURE OF A HELICAL MAGNETIC FIELD. L. M. Kovrizhnykh (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 32: 526-35(May 1962). (In Russian)

The effect of perturbations on the structure of a helical-magnetic field was analyzed. In addition to the perturbation intensity the magnitude of perturbation is determined by the helical field parameters, in particular by the magnitude of the mean velocity of the angle of turning $\omega(x)$ (non-resonance perturbations) and by its derivative along the radius $\omega'(x)$ (resonance perturbations). (R.V.J.)

28301 INVESTIGATION OF ION CYCLOTRON WAVES. N. I. Nazarov, A. I. Ermakov, A. S. Lobko, V. A. Bondarev, V. T. Tolok, and K. D. Sinelnikov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR, Kharkov). Zhur. Tekh. Fiz., 32: 536-40(May 1962). (In Russian)

Strong high-frequency discharges in hydrogen and deuterium were investigated within the ion cyclotron resonance proximity, and conditions for ion cyclotron resonance excitation and propagation along the magnetic field were determined. Measurements were made of wave polarizations, distribution of high-frequency waves along the discharge cross section, and wave attenuation in field heterogeneities. (tr-auth)

28302 HOMOGENEOUS AND NON-HOMOGENEOUS RESONANCES IN PLASMA. V. G. Baryakhtar and M. I. Kaganov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR, Kharkov). Zhur. Tekh. Fiz., 32: 554-8 (May 1962). (In Russian)

High-frequency properties of compensated plasma in a magnetic field were previously described by tensors of dielectric constants. The longitudinal oscillations in a limitless plasma are found by this method. An attempt was then made to determine natural frequencies in confined plasma. At infinity the field becomes zero and at the interface the tangential E vector components are continuous and the normal components of the vector are $D = \hat{\varepsilon}E$. Using electrostatic equations the quasistationary condition $c/\omega > L$ (where L is dimension of the body) is assumed. The problem can be resolved only for ellipsoid-shaped plasma confinement. Maxwell equations were used to analyze oscillations independent of azimuthal angle. (R.V.J.)

28303 AUTOMODULATION OF A SPIRAL ELECTRON BEAM MOVING THROUGH PLASMA IN MAGNETIC FIELD. O. A. Glasov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR, Kharkov). Zhur. Tekh. Fiz., 32: 575-8(May 1962). (In Russian)

The problem of automatic modulation of a convolute spiral electron beam moving through plasma in a magnetic field is resolved with small signal modulation. It is shown that the rise of perturbation along the beam is quite rapid. (R.V.J.)

28304 INTERACTIONS BETWEEN PLASMA CLOTS AND SPATIAL-PERIODICAL MAGNETIC FIELD. A. A. Kalmykov, V. I. Tereshin, S. A. Trubchaninov, and B. G. Safronov. Zhur. Tekh. Fiz., 32: 579-83(May 1962). (In Russian)

The motion of $\sim 10^9$ to 10^{10} cm^{-3} particle densities in spatially-periodic, time-constant magnetic fields was investigated. With certain resonance correlations with the ion component, the energy of longitudinal plasma motion is transformed into larmor ion rotation energy, thus converting up to 50% of the longitudinal energy. This method is suggested for plasma bunch injection into magnetic traps. (tr-auth)

28305 THE DISTRIBUTION OF NON-LINEAR PLASMA OSCILLATIONS ALONG MAGNETIC FIELD. [PART] II. A. D. Pataraya. Zhur. Tekh. Fiz., 32: 584-8(May 1962). (In Russian)

Nonlinear oscillations of two-component quasineutral plasma in a magnetic field were studied, considering thermal motion of the ions and electrons. The criteria for oscillations, the propagation velocity, and the length of oscillation waves were determined. (tr-auth)

28306 MOTION OF INTENSIVE PULSE ELECTRON BEAMS THROUGH DIELECTRICAL PIPES. [PART] I. A. K. Berezin, V. G. Stupak, L. I. Bolotin, and G. P. Berezina. Zhur. Tekh. Fiz., 32: 593-9(May 1962). (In Russian)

The incidence of plane monochromatic wave at the interface between an isotopic dilectric with dielectric constant ϵ_1 and a quasineutral plasma is analyzed. The collective plasma motions are described by a system of linear nonrelativistic hydrodynamic equations and Maxwell equations. (R.V.J.)

28307 INSTABILITY OF ANISOTROPIC PLASMA. A. E. Stefanovich (Inst. of Physics and Tech., Leningrad). Zhur. Tekh. Fiz., 32: 638-40(May 1962). (In Russian)

Anisotropic plasma instability in relation to transverse perturbations in the absence of a magnetic field was mathematically verified. (R.V.J.)

28308 ELECTROMAGNETIC WAVES IN MAGNETOACTIVE PLASMA OF HIGH REFRACTION COEFFICIENT. R. R. Ramazashvili and A. A. Rukhadze (Lebedev Inst. of Physics, Moscow). Zhur. Tekh. Fiz., 32: 644-7(May 1962). (In Russian)

Electromagnetic wave dispersion in magnetoactive plasma was studied at a maximum refraction index $|Z^{\alpha}| \gg 1$ in order to determine the behavior of electromagnetic waves in the proximity of cyclotron-frequency electrons and ions $\omega \sim m\Omega_{\alpha}$. The developed formulas indicate plasma is transparent to ordinary waves at $\omega < m\Omega_{\alpha}$ and to plasma waves at $\omega > m\Omega_{\alpha}$. The refraction indices and absorption coefficients for ordinary and plasma waves show $\vartheta \sim \pi/2$. (R.V.J.)

28309 IMPROVEMENTS RELATING TO ELECTRIC DISCHARGE APPARATUS. Douglas Richard Chick (to Associated Electrical Industries Ltd.). British Patent 900,288. July 4, 1962.

A toroidal discharge apparatus of the type used in thermonuclear research is designed with means of producing a strong stabilizing magnetic field. The means comprises a helical passageway encircling the main discharge path and means for passing an auxiliary heavy electric discharge along the helical passageway. (D.L.C.)

28310 IMPROVEMENTS IN OR RELATING TO APPARATUS FOR PRODUCING HIGH ELECTRIC CURRENTS. (Siemens-Schuckertwerke Aktiengesellschaft). British Patent 900,344. July 4, 1962.

An apparatus for producing high currents is designed which may be used to effect fusion reactions. The apparatus comprises a ring-shaped discharge vessel containing D_2 gas, a h-f impulse generator with an output capacity of ≥ 1 Mw, and means for producing a rotary magnetic field rotating around the discharge path from the impulse generator. (D.L.C.)

28311 SHEET PLASMA DEVICE. Oscar A. Henderson (to U. S. Atomic Energy Commission). U. S. Patent 3,044,945. July 17, 1962.

An ion-electron plasma heating apparatus of the pinch tube class was developed wherein a plasma is formed by an intense arc discharge through a gas and is radially constricted by the magnetic field of the discharge. To avoid kink and interchange instabilities which can disrupt a conventional arc shortly after it is formed, the apparatus is a pinch tube with a flat configuration for forming a sheet of plasma between two conductive plates disposed parallel and adjacent to the plasma sheet. Kink instabilities are suppressed by image currents induced in the conductive plates while the interchange instabilities are neutrally stable because of the flat plasma configuration wherein such instabilities may occur but do not dynamically increase in amplitude. (AEC)

Shielding

28312 (FXM-1474) SHIELDING FOR IRT HEAT EXCHANGERS. H. C. Honeck (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). Dec. 16, 1955. Contract [AT(11-1)-229]. 5p.

The dose from a single IRT heat exchanger located outside of the primary gamma shield was calculated for various IRT shield lead thicknesses. Equations are given. Results are presented in graph form. (M.C.G.)

28313 RADIATION SHIELDING DOORS. John M. Ruddy (Brookhaven National Lab., Upton, N. Y.). Eng. News-Record, 167: 50-1(Nov. 1961). (BNL-5262)

Radiation shielding doors are described and compared as to shielding properties at the lowest cost consistent with operating criteria. Such factors as minimum and maximum speed of opening or closing, ease of decontamination, and simplicity of maintenance are also considered. Drawings and photography of various types of doors are included. (C.H.)

28314 LEAD AND LEAD ALLOYS AS SHIELDING MATERIALS. W. Heine, K. Sagel, and U. Zwicker (Metall-Laboratorium der Metallgesellschaft A. G., Frankfurt am Main). Kerntechnik, 4: 150-5(Apr. 1962). (In German)

Special physical, mechanical, and chemical properties are required of gamma and x-ray shielding materials. Among these properties are high density and radiation stability. Lead possesses these properties but the creep resistance of pure lead is very poor. If lead is alloyed with calcium and barium its creep resistance is greatly improved. This makes the alloy an excellent material for brick-wall shielding. Because of its good corrosion resistance protective painting in most cases is not necessary. (auth)

28315 IMPROVEMENTS RELATING TO HIGH INTENSITY RADIATION PRODUCING EQUIPMENT. Donald Stanley Pettinger (to AEI-John Thompson Nuclear Energy Co., Ltd.). British Patent 901,240. July 18, 1962.

Improvements in high intensity radiation-producing equipment and in particular in the construction of a shielded pipe leading from the vessel enclosing the source of the radiation through a shield located around the vessel are described. The pipe shielding consists of a muff formed by a mass of radiation-absorbent material extending around the exterior of the pipe in the configuration of an open-coiled helix. A co-operating helical recess is placed in the wall of the pipe duct and adapted to receive the muff. The dimensions of the muff and the recess are such that relative movement between the pipe and the shield is possible and there is no direct path between the pipe and the shield for radiation from within the shield to the outside of the shield. (M.C.G.)

Theoretical Physics

28316 (NP-11902) THE THEORY OF NUCLEAR MATTER. E. Squires (Buenos Aires. Universidad. Facultad de Ciencias Exactas, Fisicas y Naturales). July 1961. 122p.

The properties of nuclear matter are discussed. The Fermi gas, interactions, perturbation theory, and hard core are described. The two chief approaches to a study of nuclear matter are discussed: the variational method of Jastrow and Dingle which consists of introducing a correlation function in the wave functions which prevents two nucleons from getting too close to each other, and the Brueckner method which replaces the potential energy between two nucleons by another expression which can be related to the reaction matrix for two nucleons and thus evaluated. Formal perturbation expansion of ground state, the low density limit, self-consistency, singularities, and the theory of superconductivity are also discussed. The Jastrow method did not give as accurate results as the Brueckner method. (M.C.G.)

28317 PARTICLE-LIKE SOLUTIONS IN FIELD THEORY. Eugene P. Gross (Brandeis Univ., Waltham, Mass. and CERN, Geneva). Ann. Phys. (N. Y.), 19: 219-33(Aug. 1962).

A number of quantum field theories have the property that the field equations, studied as classical equations of motion, have particle-like solutions. These are spatially localized exact solutions, with a definite value of angular momentum. The role of these solutions in a fully quantum theory is the subject of investigation. In particular, the theory of a nonrelativistic scalar nucleon, coupled by a local interaction to a scalar meson field, is examined. The classical solution (whose spatial extent is a nucleon Bohr radius) is identified with a self-consistent field approximation to the one-nucleon state. However, quantum corrections to this approximation yield the same divergent self-energy as perturbation theory. In this example, the particle-like solutions have nothing to do with the ultraviolet divergences, but are relevant to the treatment of the finite part of the theory for strong coupling. The separation of the infinite part is trivial and is accomplished by a canonical transformation. The particle solutions still exist for the finite part for strong coupling. (auth)

28318 AN EXTENSION OF THE REGGE FORMULA. S. Mandelstam (Univ. of Birmingham, Eng.). Ann. Phys. (N. Y.), 19: 254-61(Aug. 1962).

The Regge formula is modified so as to incorporate the analytic properties of the scattering amplitude in the complete l-plane. The asymptotic behavior of the background term (previously $z^{-\frac{1}{2}}$) can thereby be made arbitrarily small, and a formal asymptotic expansion of the scattering amplitude can be obtained. (auth)

28319 APPLICATION OF STURMIAN FUNCTIONS TO THE SCHROEDINGER THREE-BODY PROBLEM: ELASTIC e^+-H SCATTERING. Manuel Rotenberg (Univ. of California, San Diego, La Jolla). Ann. Phys. (N. Y.), 19: 262-78(Aug. 1962).

The properties of a set of eigenfunctions closely related to Schroedinger wave functions are exploited to deal with certain three-body problems. These functions, termed Sturmian functions, have a distinct advantage over Schroedinger functions when used as an expansion basis since they form a complete set without a continuum, regardless of the potential existing between the particles. This enables one to examine, for example, the mechanism of polarization of the deuteron in elastic N-D scattering. Further use of the Sturmian functions can be made in describing elastic scattering of electrons and positrons from hydrogen. A detailed calculation of elastic scattering of positrons from atomic hydrogen is carried out. It is shown that Sturmian functions converge rapidly when they are used as an expansion basis, and provide phase shifts which are slightly greater than rigorous lower bounds provided by a variational treatment. (auth)

28320 ELECTROMAGNETISM, GEOMETRY, AND THE EQUIVALENCE PRINCIPLE. Asher Peres (Princeton Univ., N. J.). Ann. Phys. (N. Y.), 19: 279-86(Aug. 1962).

The geometrical properties of space-time are usually measured with the help of macroscopic bodies, the behavior of which is essentially governed by electromagnetic forces. It is therefore suggested to consider the electromagnetic field as fundamental, and the metric field only as a subsidiary quantity. It turns out, however, that the metric field is not uniquely determined by the Maxwell equations, so that additional requirements can be imposed. If one requires that the geometry be as "simple" as possible, he is naturally led to a variational principle of the Einstein-Maxwell type, showing that the electromagnetic energy-momentum tensor acts as a source for the metric field. This is just another statement of the equivalence principle: the latter should therefore be considered as a consequence of the fact that the geometrical properties of space-time are measured with instruments possessing energy and momentum. (auth)

28321 RADIATION DAMPING IN CLASSICAL ELECTRODYNAMICS. Ted Clay Bradbury (Los Angeles State Coll.). Ann. Phys. (N. Y.), 19: 323-47(Aug. 1962).

The problem of radiation from a charged particle in uniform acceleration is considered. It is shown that, by transforming from an inertial frame to the accelerated frame in which the particle is at rest, the magnetic field, and hence the radiation, is transformed away. Exact solutions of Maxwell's equations in the accelerated frame are obtained. Dirac's classical equations of motion of a charged particle are rederived for the special case of one-dimensional motion. By doing the calculation in the permanent (noninertial) rest frame of the charged particle, it is shown that it is not necessary to use advanced fields as was done by Dirac. The calculation requires no modification of the energy-momentum tensor. The theory still contains a divergent term (as does Dirac's) but in a modified form. A simple solution for one-dimensional motion is considered. By consideration of a case where an electron enters from a region of no field, passes through the region of the field and then again into a region of no field, it is shown that the conventional power radiation formula gives the same answer for the total power radiated as does Dirac's equation. Hyperbolic motion is considered as a limiting case of motion through a finite region of space where there is a uniform electric field. The region where the field is defined is then allowed to become large compared to the electron radius. (auth)

28322 APPLICATION OF THE IMPROVED BORN-OPPENHEIMER METHOD TO THE THREE-CHARGE PROBLEM. C. Joachain and N. Wantiez (Université Libre, Brussels). Bull. classe sci., Acad. roy. Belg., (5) 48: 197-215(1962). (In English)

The improved Born-Oppenheimer method is discussed and applied to three-charge problems with two equal masses. Numerical results are given for the mesic molecular ions $(pp\mu^-)$ and $(dd\mu^-)$. (auth)

28323 TENSORIAL INTEGRAL CONSERVATION LAWS IN GENERAL RELATIVITY. J. L. Synge (Dublin Inst. for Advanced Studies). Colloq. intern. centre nati. recherche sci. (Paris), 91: 75-83(June 1959).

Integral conservation laws having a tensorial character are proposed that are obtained by the use of the generalized Stokes' theorem and the 2-point invariant "world function." (tr-auth)

28324 TRANSFORMATION OF WAVE FUNCTIONS IN A GALILEAN CHANGE OF REFERENCE. Claude Budin. Compt. rend., 254: 3636-8(May 21, 1962). (In French)

The potential of pulse velocities in fluid mechanics was calculated and applied to the transformation of wave functions in functional theory and wave mechanics. (tr-auth)

28325 FORMULATIONS OF GAUGE INVARIANCE. Kuo-Hsien-Tzou. Compt. rend., 254: 3819-21(May 28, 1962). (In French)

A generalized formulation of gauge invariance assured in appearance by a boson of spin 0 is discussed. This formulation is compared with the usual formulation of this invariance assured by a boson of spin 1. (tr-auth)

28326 A NEW VARIATIONAL PRINCIPLE IN QUANTUM MECHANICS. Theodore Joseph Newman (Brooklyn Polytechnic Inst.). Dissertation Abstr., 22: 1217(Oct. 1961).

Quantum theory is developed from a q-number (operator) action principle with a representation-invariant technique for limiting the number of independent system variables. It is shown that in a q-number theory such a limitation on the number of variations is necessary, since a completely arbitrary q-number variation implies an infinite number of conditions to be satisfied. This implication arises because, in a q-number theory, the system variables are matrices which, in most cases, have an infinite number of elements, each of which is independently varied in a completely arbitrary q-number variation. A review of Schwinger's quantum field theory formalism shows that the limitation to c-number variations, while accomplishing the desired limitation on the number of independent variations, is not representation-invariant, i.e., under a change of representation, c-number variations applied to the original system variables transform to q-number variations of the new system variables. In the Hamiltonian formulation of classical mechanics, invariant infinitesimal canonical transformations are generated by constants of the motion. It is also possible to generate infinitesimal invariant transformations from constants of the motion in the classical Lagrangian formulation. This latter possibility is exploited to obtain a q-number theory. It is demanded that the variations of the system variables in the action principle be the invariant infinitesimal transformations generated by constants of the motion. This requirement accomplishes the desired limitation of the number of independent variations in a representation-invariant manner. The resulting theory is developed in detail for a certain class of Lagrangian functions. A set of commutation relations is derived and a dynamical principle for determining the temporal development of the system is postulated. A discussion of the results, including consideration of the self-consistency of the formalism developed, is presented. Finally, a specific problem is worked through and it is shown that the results obtained correspond with those of the canonical method of quantization.

28327 INVESTIGATIONS ON THE STATISTICAL MODEL OF THE MESON THEORY. Guenther Rasche (Universität, Zurich). Helv. Phys. Acta, 35: 69-97(1962). (In German)

A variational principle given by Schwinger is used for meson processes treated by the static fixed source model. The non-renormalized π-N coupling constant f^2 (f_r^2 = renormalized coupling constant) is calculated for the purpose of ascertaining whether the theory is consistent and leads to a unitary S-matrix (which is only the case when $f^2 \geq (\frac{1}{2})$. The result is that for a cut-off ω_{max} less than about 4.5 $m_\pi c^2$ and $f_r^2 = 0.08\ f^2$ lies between 0.15 and 0.25 and the theory is consistent. For higher values of ω_{max} the approximations are not reliable but the indications are that the theory ceases to be consistent for a sufficiently high ω_{max}. The variational principle is also applied to double meson production and the results are similar to those derived with various approximations from the Chew-Low equations. (auth)

28328 ON A POSSIBLE GENERALIZATION OF MODERN QUANTIZED FIELD THEORY. Yu. M. Lomsadze, I. Yu. Krivskii, and I. V. Khimitch (Uzhgorod State Univ., Ukrainian SSR). Nuclear Phys., 33: 566-79(June 1962). (In English)

The fundamentals of the theory of the quantized "probability amplitude field" are formulated. The theory is a specific generalization of the conventional quantized field theory, increasing still more the extent of its probability character; the state vector of the physical system is not a functional, as in the quantized field theory, but a hyperfunctional. The new theory is shown to satisfy a principle of correspondence with the conventional quantized field theory. (auth)

28329 COVARIANT THEORY OF RELATIVISTIC WAVE EQUATIONS. L. A. Shelepin (Lebedev Inst. of Physics, Moscow). Nuclear Phys., 33: 580-93(June 1962). (In English)

The results of an investigation on the application of the Racah methods to the theory of relativistically invariant equations is developed in convenient covariant terms, the theory of relativistic equations being presented as a theory of transformation matrices. The commutation relation constants determining the U(α)-algebra are connected with the parameters of the equations. Analytical formulae are found for the trace of arbitrary products of the matrices of any relativistically invariant equation. Formulae are obtained for the transition to the parametric form of notation, making it possible to express any equation via the direct products of the Dirac matrices. General formulae are given for the transition to the Gelfand-Yaglom representation. Examples are cited. (auth)

28330 SPIN AND STATISTICS WITH AN INDEFINITE METRIC. Richard Spitzer (Argonne National Lab., Ill.). Nuclear Phys., 33: 614-25(June 1962). (In English)

A theory of spin-$\frac{1}{2}$ bosons and spin-0 fermions formulated with an indefinite metric for physical states is considered. The requirement that squares of S-matrix elements be interpretable as probabilities in the usual sense is formulated in terms of a symmetry principle as a consequence of which states with positive norms become separated from those with negative norms by a superselection law. The symmetry transformation, called metric conjugation, is induced by the metric operator and is non-local. An example of an interaction invariant under metric conjugation is shown to lead to a unitary S matrix and to a theory that admits a causal interpretation in the sense of Stueckelberg. Some consequences of the assumption that the muon is a spin-$\frac{1}{2}$ boson are discussed. The theory then provides a physical basis for the absence of the decays $\mu \rightarrow e + \gamma$, $\mu \rightarrow 3e$ in the sense that the conservation law which leads to these selection rules is the one required for

the theory to admit a physical interpretation. The same conservation law forbids muon pair production. (auth)

28331 A VARIATIONAL PRINCIPLE FOR BRUECKNER THEORY. J. Da Providencia (Universidade, Coimbra, Portugal). Nuclear Phys., 36: 169-76(July 1962). (In English)

Schwinger's variational principle for scattering problems is applied to boundstate problems. A new upperbound to the energy shift due to a nonpositive perturbation was obtained. A variational principle which yields Brueckner theory is presented and applied in a new derivation of Moszkowski and Kibler equations. The effect of second order variations is investigated. (auth)

28332 A NOTE ON THE ANGULAR DISTRIBUTION OF INELASTICALLY SCATTERED PARTICLES IN COULOMB EXCITATION. T. A. Griffy and L. C. Biedenharn (Duke Univ., Durham, N. C.). Nuclear Phys., 36: 452-6 (Aug. 1962). (In English)

The angular distribution of the inelastically scattered particles following Coulomb excitation is calculated for electric quadrupole transitions. The quantum mechanical calculations are performed for the case of finite energy loss and a comparison is made between the semi-classical and quantum mechanical angular distributions. (auth)

28333 USE OF AN INFINITE ENERGY PHOTON FOR THE DETERMINATION OF THE ASYMPTOTIC FORM OF THE CANONICAL PROPAGATOR. B. Jouvet (College de France, Paris). Nuovo cimento (10), 25: 135-68(July 1, 1962). (In French)

Canonical relations on one side and the formulation of gauge invariance for a photon having a bare mass on the other side give two relations between the main weight functions which characterize the propagators of the photon and the electron. Using a limiting process, a prime integral, divergent and ambiguous, which determines formally the asymptotic behavior of the photon propagator to all orders of perturbation theory is obtained. After a demonstration of that result the ambiguities occurring in the prime integral and in the limiting process are resolved using the supplementary information implied by the physical context and the postulate of canonical formalism. Consequences of gauge invariance are also used. The ambiguous prime integral can then be cast into integral equations. As tests of the validity of this method, results in agreement with the known properties of the lowest orders of perturbation theory are obtained, and it is shown that the nonperturbative solutions of the integral equations are equivalent. (auth)

28334 REGGE POLES IN RELATIVISTIC SCHRÖDINGER THEORY. R. Oehme (Univ. of Chicago). Nuovo cimento (10), 25: 183-92(July 1, 1962). (In English)

The Regge trajectories $\alpha(E)$ associated with the scattering of relativistic particles at a Coulomb potential are considered as analytic functions of the energy E. The trajectories for particle and antiparticle scattering are related by a simple crossing relation. In addition to the branch points at $E = \pm m$, the functions $\alpha(E)$ have complex branch points related to the possibility of a collapse into the center. Corresponding singularities are expected for a Yukawa potential resulting from a vector meson interaction. The possible relevance of these results for relativistic dispersion theory is discussed. (auth)

28335 CO-ACTING OF CLASSICAL DOPPLER SHIFT AND TIME DILATION. Oswald Riedel (Badische Anilin- und Soda-Fabrik A. G., Ludwigshafen am Rhein, Ger.). Nuovo cimento (10), 25: 237-41(July 16, 1962). (In English)

Frequency shifts that occur between objects moving in gravitational fields are caused by a combination of the classical Doppler shift and relativistic time dilation. The method of obtaining relativistic Doppler formulas by multiplying together classical and relativistic quantities is shown to be invalid. An exact formula for the general-relativistic effect does not exist; approximations of a sufficient accuracy, however, are procurable. (auth)

28336 FIELDS SATISFYING THE ASYMPTOTIC CONDITION. R. F. Streater (Imperial Coll. of Science and Tech., London). Nuovo cimento (10), 25: 274-86(July 16, 1962). (In English)

It is proved that a necessary and sufficient condition that a local current should be the current of a local field satisfying the asymptotic condition, is that the time-ordered products of the current should have the same one-particle singularities as those from all Feynman graphs that can be disconnected by cutting one internal line. It is shown that a field theory with a unique vacuum and one-particle state, and satisfying the asymptotic condition, is defined by its set of reduced Wightman functions (whose spectra begin at the threshold of the 2-particle continuum). The problem of ensuring that the space of states has a positive definite metric is not solved. (auth)

28337 SOME REMARKS ON TIME AND ENERGY AS CONJUGATE VARIABLES. S. Hjalmars (Royal Inst. of Tech., Stockholm). Nuovo cimento (10), 25: 355-64(July 16, 1962). (In English)

The possibility of treating the time in classical mechanics as a dynamical variable and not as a parameter is strongly suggested by the theory of relativity and by the correspondence to quantum theory. The most natural way to realize this possibility seems to be to introduce a new integration parameter instead of the time in the principle of Hamilton. However, this simple procedure gives a constraint between the generalized co-ordinates and momenta, which makes it impossible to follow the standard Hamiltonian pattern. It is shown that the parametrized principle of Hamiltonian can be modified in two different ways so as to give a complete Hamiltonian formalism, possessing a first integral, which makes the equations of motion identical with the ordinary ones. It is pointed out that both these modifications can be considered as limiting cases of the relativistic principle of Hamiltonian for a charged particle in an electromagnetic field. (auth)

28338 BOUND-STATE PERIPHERAL WAVE FUNCTION. L. Bertocchi (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 25: 416-27(July 16, 1962). (In English)

Using the symmetry point conditions, the coupling constant for the nucleus-nucleon interaction is defined. In this way it is possible to obtain the form of the "peripheral" wave function of a nucleus. (auth)

28339 COMPLETENESS IDENTITY IN FIELD THEORY. O. W. Greenberg (Univ. of Maryland, College Park), H. J. Schnitzer, and E. C. G. Sudarshan. Nuovo cimento (10), 25: 461-4(July 16, 1962). (In English)

A Heisenberg field A(k) that is smeared in momentum space is assumed to act on an (assumed cyclic) unique vacuum state $|0\rangle$. A complete orthogonal basis of the Hilbert space generated by this interaction is constructed, by Gram-Schmidt orthogonalization of the state vectors representing the interaction. This orthogonal basis is then used to determine an expression for the unit operator 1 (the so-called completeness identity). It is noted that alternative completeness identities may be used to test the compatibilities of different completeness assumptions. For

simplicity, only neutral scalar fields are considered. (T.F.H.)

28340 ON THE COMPATIBILITY OF RELATIVISTIC WAVE EQUATIONS IN RIEMANN SPACES. H. A. Buchdahl (Univ. of Tasmania, Hobart, Australia). Nuovo cimento (10), 25: 486-96(Aug. 1, 1962). (In English)

It is noted that the "natural generalization" to a Riemann space V_4 of a certain set of flat-space free-field equations for particles of spin $S = \frac{1}{2}$ is internally consistent if and only if the V_4 is an Einstein space. It is shown that, apart from this case, all equations for particles of spin $S \geq \frac{1}{2}$ that may be said to conform to a "strong principle of equivalence" are compatible if and only if the V_4 is of constant Riemannian curvature. The corresponding second-order wave equations in such a space are written down. Certain modified first-order equations for the case $S = 2$, which involve the curvature tensor explicitly, are shown to be consistent in an Einstein space. (auth)

28341 COVARIANT QUANTIZATION OF THE GRAVITATIONAL FIELD. John R. Klauder (Univ. of Bern and Bell Telephone Labs., Murray Hill, N. J.). Nuovo cimento (10), 25: 542-64(Aug. 1, 1962). (In English)

In any quantum theory in which the metric tensor of Einstein's gravitational theory is also quantized, it becomes meaningless to ask for an initial space-like surface on which to specify the conventional field commutators. The covariant quantum formalism, in which all fields either commute or fail to do so only when the fields' points coincide, is proposed as being suitable to quantize gravity. The extension of the covariant quantum formalism to general boson fields that interact in an intrinsically nonlinear way with external fields is analyzed. This formalism is applied to the case of the free gravitational field. In a functional representation, the measure on metrics is found. A basic state of the quantized gravitational theory is proposed, which involves a summation over all permissible metrics in the entire space-time manifold. (auth)

28342 AN AXIOMATIC APPROACH TO THE THEORY OF RENORMALIZATION. N. Tarimer (Middle East Technical Univ., Ankara). Nuovo cimento (10), 25: 572-9(Aug. 1, 1962). (In English)

An axiomatic U-matrix dynamics is formulated in a way that does not contradict Haag's theorem. The motivating idea is the following: if the scales of the clocks are changed such that a finite time interval is mapped onto an infinite interval, the S-matrix of the second system will be equivalent to the U-matrix of the first. Therefore the problem is solved by investigating the properties of the S-matrix in certain noninertial frames of reference. It is proved that such a dynamic structure leads to a finite theory of renormalization, where the ideas of conventional theories acquire precise mathematical significance. It is suggested that this formalism may be useful in the computation of explicit renormalization effects, such as the $\pi^0-\pi^-$ mass difference. (auth)

28343 ON THE EQUIVALENCE BETWEEN PSEUDOSCALAR AND PSEUDOVECTOR COUPLINGS. C. G. Bollini (Universidad, Buenos Aires). Nuovo cimento (10), 25: 670-7(Aug. 1, 1962). (In English)

A proof is given of the equivalence between the pseudoscalar coupling theory, and a pseudovector coupling theory in which the propagator of the fermion field is simply $(p^2 + m^2)^{-1}$. In the latter theory only two couplings are present. One is the pseudovector interaction and the other is a second-order term containing the squares of both the fermion and the boson fields. No other kind of interaction (or nonlinearity) is necessary for the equivalence to hold in any order of the perturbation expansion. (auth)

28344 A DYNAMICAL EQUATION FOR THE JOST FUNCTION. V. De Alfaro, T. Regge, and C. Rossetti (Università, Turin and Istituto Nazionale di Fisica Nucleare, Turin). Nuovo cimento (10), 25: 701-3(Aug. 1, 1962). (In English)

By means of on-shell calculations for potential scattering, an integral representation is found for the Jost function $F(\lambda,k)$, which displays analytic properties in both the angular momentum $l = \lambda - \frac{1}{2}$ and the energy $s = k^2$. Further, an integral equation is found for the spectral function contained in the representation of $F(\lambda,k)$. The calculations are carried out with the aid of suggestions from the first Born approximation. (T.F.H.)

28345 EXPANSION OF THE SCATTERING AMPLITUDE IN RELATIVISTIC SPHERICAL FUNCTIONS. I. S. Shapiro (Inst. of Theoretical and Experimental Physics, Academy of Sciences, Moscow). Phys. Letters, 1: 253-5 (July 1, 1962). (In English)

Irreducible representations of the Lorentz homogeneous group are examined. Scattering amplitudes of zero-spin particles having equal masses are considered; generalization to cases of particles having spins and different masses is not difficult. (L.N.N.)

28346 A CANONICAL FORMALISM WITH A LINEAR SUPPLEMENTARY CONDITION. [PART] I. Yasushi Takahashi (Dublin Inst. for Advanced Studies). Phys. Letters, 1: 278-9(July 1, 1962). (In English)

A method useful from the view point of quantization is applied to the Bogoliubov-Tyablikov transformation for particle interactions with quantized fields. (L.N.N.)

28347 A CANONICAL FORMALISM WITH A LINEAR SUPPLEMENTARY CONDITION. [PART] II. Yasushi Takahaski (Dublin Inst. for Advanced Studies). Phys. Letters, 1: 279-80(July 1, 1962). (In English)

A method useful from the view point of quantization (Y. Takahashi, Physics Letters, 1: 278(1962)) for the Bogoliubov-Tyablikov transformation for particle interactions with quantized fields is applied to a many-body problem. (L.N.N.)

28348 UPPER LIMITS FOR COUPLING CONSTANTS IN FIELD THEORIES. M. A. Ruderman (Univ. of California, Berkeley). Phys. Rev., 127: 312-20(July 1, 1962).

Upper bounds to the magnitude of the coupling constant for the vertex $A + B \rightarrow C$ are explored for meson theories with spatially fixed sources and also for the full relativistic theory without approximation. Two types of limit are obtained which depend upon whether or not the vertex $A + \bar{B} \rightarrow D$ exists where $\bar{B}$ is the antiparticle to B and D is stable. Any greater value is inconsistent with unitarity and the mass spectrum of stable particles. In fixed-source theories, the limits can be explicitly expressed in terms of simple properties of the given source function; in the nonapproximated relativistic theory they involve knowledge of the number or position of the nodes of the single-partial wave absorptive amplitude on the nonphysical (left-hand) cut. When inelastic scattering of A by B is neglected and the mass of C is only slightly less than the sum of the masses of A and B, the upper bounds are equal to each other and to the coupling constant if C is a pure bound state of A and B. (auth)

28349 FORMULATION OF THE SCATTERING FUNCTIONS IN TERMS OF THE UNITARY REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP. A. O. Barut (Univ. of California, Berkeley). Phys. Rev., 127: 321-3(July 1, 1962). (UCRL-9963)

A group-theoretical basis of the axiomatic S-matrix theory is presented. The unitarity condition is taken as the scalar product of the scattering functions which transform according to the unitary representations of the inhomogeneous Lorentz group. The general transformation property of the invariant scattering functions is given which allows one, in principle, formulation of these functions for arbitrary processes. (auth)

28350 NON-ABELIAN GAUGE FIELDS. RELATIVISTIC INVARIANCE. Julian Schwinger (Howard Univ., Cambridge, Mass.). Phys. Rev., 127: 324-30(July 1, 1962).

A simple criterion for Lorentz invariance in quantum field theory is stated as a commutator condition relating the energy density to the momentum density. A relativistically invariant radiation-gauge formulation is devised for a nonAbelian vector-gauge field coupled to a spin-½ Fermi field. (auth)

28351 RENORMALIZABILITY OF GAUGE THEORIES. Abdus Salam (Imperial Coll., London). Phys. Rev., 127: 331-4(July 1, 1962).

By generalization of methods developed by Kamefuchi, O'Raifeartaigh, and Salam, conditions for renormalizability of general gauge theories of massive vector mesons are derived. These conditions are stated explicitly. It is shown that all theories based on simple Lie groups (with the exception of the neutral vector meson theory in interaction with a conserved current) are unrenormalizable. (auth)

28352 SIGNIFICANCE OF SPATIAL ISOTROPY. P. J. Peebles and R. H. Dicke (Princeton Univ., N. J.). Phys. Rev., 127: 629-31(July 15, 1962).

It has been suggested occasionally that the fine structure "constant" may not be a fixed number, but that it may be determined, in a manner not yet understood, by the distribution of mass in the universe. A simple point-particle picture is used to indicate the significance of this idea for the motion of free test particles. The possible generally covariant equations of motion for a point particle are considered, and it is shown that one can find a suitable model which is consistent with the observed structure independence of gravitational acceleration. However, it is indicated that such a model is not consistent with the precise observations, made by Hughes et al. and Drever, of the local isotropy of space. That is, with the observed structure independence of gravitational acceleration and local isotropy of space, and assuming general covariance, it seems to be necessary to rule out any appreciable variation with position in the value of the fine structure constant. (auth)

28353 ANALYTICITY IN THE COMPLEX ANGULAR MOMENTUM PLANE OF THE COULOMB SCATTERING AMPLITUDE. Virendra Singh (Univ. of California, Berkeley). Phys. Rev., 127: 632-6(July 15, 1962). (UCRL-9972)

The complex angular momentum J-plane analytic properties of the scattering amplitude for Coulomb potential have been studied. It is found that the only singularities are poles (Regge poles) in the J plane. These poles are discussed in detail, with their application to relativistic S-matrix theory kept in view. (auth)

28354 MEROMORPHIC PROPERTY OF THE S MATRIX IN THE COMPLEX PLANE OF ANGULAR MOMENTUM. Hung Cheng (California Inst. of Tech., Pasadena). Phys. Rev., 127: 647-8(July 15, 1962).

A proof is given for the meromorphic nature of the S matrix in the entire complex plane of the angular momentum, under quite general assumptions for the potential. Some properties for the S matrix in the complex angular momentum plane are discussed. (auth)

28355 SOME EXPERIMENTAL CONSEQUENCES OF TRIANGLE SINGULARITIES IN PRODUCTION PROCESSES. P. V. Landshoff and S. B. Treiman (Princeton Univ., N. J.). Phys. Rev., 127: 649-52(July 15, 1962).

The infinite anomalous threshold singularities in the amplitude for a production reaction may, in certain circumstances, lie close to the physical region. The possibility then arises that they can be "detected" through characteristic peaking effects which they produce, as sometimes happens for the more familiar pole-type singularities. Examples based on triangle graphs are discussed. (auth)

28356 ON THE COLLECTIVE MODEL WAVE FUNCTIONS. Zlatko Janković (Institut "Rudjer Bošković", Zagreb). Radovi jugoslav. akad. znanosti i umjetnosti, 325: 26p. (1961). (In English)

Collective model wave functions are determined for a particular Hamiltonian. The orthonormalized β part of the wave functions is determined by confluent hypergeometric functions, in which orthonormalized generalized Laguerre polynomials play the most important role. A constructive method for obtaining the γ part is developed and its application illustrated in obtaining explicitly a few $g(\gamma)$ functions for $I \leq 5$. Wave functions for a slightly generalized Hamiltonian, for small and vanishing equilibrium values β_0 and γ_0 and for anharmonic potential energy terms, are also determined, generalized Laguerre polynomials playing again the most important role. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 26955, 27196, and 27546.

28357 (ANL-6539) IDAHO DIVISION SUMMARY REPORT, APRIL THROUGH SEPTEMBER 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 119p.

Research and development progress is reported on TREAT, BORAX V, ZPR-III, EBR-II, and the reactor operations personnel training program. (M.C.G.)

28358 (ANL-6580) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JUNE 1962. (Argonne National Lab., Ill.). July 15, 1962. Contract W-31-109-eng-38. 58p.

Research and development progress is reported on water-cooled reactors, liquid metal-cooled reactors, general reactor technology, plutonium recycle, advanced systems research and development, and nuclear safety. Topics covered include the EBWR, BORAX-V, EBR-I, EBR-II, FARET, applied reactor physics, reactor fuels development, reactor materials development, reactor components development, heat engineering and fluid flow, chemical separations, Argonne Advanced Research Reactor, subcritical reactor as substitute for isotope heat sources, thermal reactor safety studies, fast reactor safety studies, and direct conversion studies. (M.C.G.)

28359 (BAW-1107) LIQUID METAL FUEL REACTOR EXPERIMENT. Quarterly Technical Report, January–March 1958. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). [July 1958]. Contract AT(30-1)-1940. 144p.

Progress on the corrosion loop program was directed toward the completion of additional loops and their early operation. Comparison of early tests with and without zirconium confirmed the advantages of zirconium as an additive. Precipitation of uranium from solution onto surfaces of the pump sump presented a problem. This condition was corrected by changing the fluid flow of the bismuth in the pump sump and the addition of heaters to maintain temperatures even in inert gas spaces. The capsule test facilities were increased from 20 to 40 to satisfy a larger program on different phases of materials compatibility. Eight stations for stress rupture testing in bismuth were put into operation and the first specimen was carried to rupture. Additional check tests of the same materials in air are also being run. Several important problems pertaining to the Engineering Test Reactor in-pile loop were worked out. A reduction in space available at the reactor was made acceptable by improved shielding designs. A vendor's difficulty with valves was expedited to improve delivery. Uncertainties as to the gamma heating of the in-pile section were worked out through a change in design of the in-pile piece and cooling procedures. Further tests on the graphite available from vendors indicated that the graphite is not impervious. Leakage through the graphite and absorption of bismuth was observed. Construction of test apparatus for valves has continued. New projects of a prototypal nature were initiated including a study of induction heating, filters for liquid bismuth, and fatigue tests on bellows. Proposals on the study of cavitation and additional work on graphite are under discussion. The investigation of welding procedures suitable for remote application proceeded with considerable success. High frequency induction welding was used on Croloy 2¼ tubing up to 6⅝-in. OD. Uniformity and quality of weld were improved by additions of laminations at the inductor, limit switches, a time delay circuit, and induction heat treatments. The gas shielded consumable method was used on Croloy 2¼ pipe up to 8¼-in. OD. Development of analytical procedures was completed for zirconium and oxygen by wet chemical procedures, for magnesium, zirconium, and a part of the rare earths by spectrographic procedures and some by flame photometry. Additional work in the general field of chemical processing includes initial studies on a device to sparge out fission gases, and participation in a program to determine the solubility of uranium in bismuth. Initial basic studies on slurries was directed toward the suspension of thoria in bismuth. Experimental work leading to wetting and study of particle size and agglomeration was begun. A slurry test loop was put into operation and specified conditions of slurry concentrations, etc., will be established following the basic studies. The main chemical processing effort was spent on studies related to both the LMFRE and the LMFR. LMFRE solubility research was performed, and other aspects of reactor chemistry were pursued. A research specification was prepared for analytical problems related to remote gas phase and liquid phase analyses of trace elements in the ETR loop tests. Much thought was given to the design of a flexible reactor off-gas system, and the recommended system is presented. A proposal for an extensive slurry research program was prepared. The economics of possible chemical processing plants associated with future LMFR's were investigated, and costs are presented for both aqueous processing of an oxide slurry and fluoride volatility processing of a bismuthide slurry. Calculations of the expected range of U^{233} and Pa^{233} separation efficiencies in the head end processing of a bismuthide slurry also were performed since these efficiencies are a major factor in dictating the cost of pyroprocessing. (auth)

28360 (DP-693) HIGH LEVEL NEUTRON FLUX MONITOR FOR REACTOR USE. Robert V. Studley (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Apr. 1962. Contract AT(07-2)-1. 14p.

Reliable flux monitoring for nuclear reactors is provided by an instrument that measures currents between 1×10^{-9} and 3×10^{-4} amp from a neutron-sensitive ion chamber. Three adjustable high level alarms are available. The average failure frequency for this circuit has been about one per seven years. (auth)

28361 (GAMD-2797(Vol.I)) DDB—A TWO DIMENSIONAL REACTOR DIFFUSION CODE WITH CRITICALITY SEARCH AND BURNOUT OPTIONS. VOLUME I. J. H. Alexander, C. Cyl-Champlin, J. E. Gratteau, P. C. Kaestner, E. J. Leshan, and W. A. Growdon (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Mar. 15, 1962. Contract AT(04-3)-314. 155p.

Duo-Dimensional Burnout (DDB) is a five-group, two-space-dimensional reactor diffusion code with burnout options. A maximum of four thousand mesh points are allowed; down scattering two groups from the third group and upscattering one group from the fifth group is allowed. DDB may be used to perform static calculations with or without a criticality search to obtain flux and power distributions. DDB is written in the FORTRAN 7090 language to facilitate modification. The diffusion portion of DDB is basically a translation into FORTRAN of the UCRL program

ANGIE. A set of special tape subroutines are used to take maximum advantage of the IBM 7090's ability to do multiple tape operations while performing calculations. Operating experience indicates that the diffusion calculations running time compares quite favorably with ANGIE. (auth)

28362 (GAMD-2797(Vol.II)) DDB—A TWO DIMENSIONAL REACTOR DIFFUSION CODE WITH CRITICALITY SEARCH AND BURNOUT OPTIONS. II. THE PROGRAM. J. H. Alexander, C. Cyl-Champlin, J. E. Gratteau, P. C. Kaestner, E. J. Leshan, and W. A. Growdon (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Mar. 15, 1962. Contract AT(04-3)-314. 400p.

28363 (GEAP-3253) N. S. SAVANNAH FUEL DESIGN AND DEVELOPMENT PROGRAM. FUEL ROD VIBRATION. Preliminary Report. J. A. Bailey and Charles M. Shields (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 25, 1959. Contract AT(04-3)-189. 18p.

An investigation was made of the N. S. Savannah replacement fuel rod vibration amplitude when excited by water flowing parallel to the axis of the fuel rod. Methods of calculating the fuel rod natural frequency in air were verified by experiment. Work is continuing to establish the validity of methods of calculating natural frequencies in water and to confirm the correlation of flow-induced vibration amplitude found previously. On the basis of the tests and analysis, the maximum amplitude of flow-induced fuel rod vibration was found to be 3×10^{-3} inches. (auth)

28364 (GEAP-3869) MARITIME LOOP IRRADIATION PROGRAM. SAVANNAH I FUEL IRRADIATION. Quarterly Progress Report July 1, 1961 to September 30, 1961. D. W. Danielson and R. S. Gilbert (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Dec. 21, 1961. Contract AT(04-3)-189. 17p.

The S-I-5-B-M fuel irradiation in the GETR Maritime Loop is covered. Fuel performance, fuel environment, problems with loop operation, and the fuel interim examinations are discussed. The loop fuel burnup accumulated during the period was 1065 Mwd/ton U with the total burnup of 2672 Mwd/ton U. (M.C.G.)

28365 (IDO-16755) CONTRIBUTIONS TO TWO PROBLEMS IN SPACE-INDEPENDENT, NUCLEAR-REACTOR DYNAMICS: I. CALCULATION AND MEASUREMENT OF THE REACTOR DESCRIBING FUNCTION. II. ANALYSIS OF THE EFFECT OF A REFLECTOR ON REACTOR DYNAMICS (thesis). A. A. Wasserman (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Mar. 30, 1962. Contract AT(10-1)-205. 411p.

Submitted to Massachusetts Inst. of Tech., Dept. of Chemical Engineering, Cambridge.

Analytical and experimental studies on the describing function of a nuclear reactor and analytical studies on the effect of a reflector on reactor dynamics were carried out. Earlier analytical work on the reactor describing function both at low and high power levels was substantially extended and clarified. Some of the earlier results on the high-power reactor describing function were shown to be incomplete or incorrect. Several IBM-650 programs were written to facilitate accurate calculation of the low- and high-power reactor describing function for a variety of reactor types, and illustrative calculations were presented. The analytical results for the low-power describing function were confirmed by pile-oscillator, frequency-response measurements in a small, enriched, plate-type, H_2O-moderated and -reflected reactor (the Spert-I P-18/19 reactor), for reactivity amplitudes up to \$0.145 and for frequencies from 0.002 to 18.4 cps. A reflector-located, rotary, reactivity-oscillator mechanism of adjustable reactivity amplitude was used. Agreement between the experimental and theoretical describing-function results was shown to be better when a slightly modified version of Keepin and Wimett's U^{235} fast-fission delayed-neutron data were used for the calculations than when Keepin and Wimett's thermal-fission data were used, regardless of the reactivity amplitude or the method of data handling. By means of tests with the neutron detector placed in various positions about the core periphery, the space and time variations of the neutron density, for a reactivity amplitude of \$0.064 and frequencies up to 18.4 cps, were shown to be separable everywhere except in the immediate vicinity of the asymmetrically located oscillator. The prompt-neutron generation time was deduced from the experimental results and found to be in good agreement with results obtained in short-period, step-transient tests and in static, 1/v-poison perturbation tests. Analysis of the effect of a reflector on reactor dynamics showed that, under appropriate conditions, the effective lifetime of a reflected reactor can become frequency-dependent at high frequencies, causing the reactor response to rapid reactivity changes to differ from that of an equivalent bare reactor having the same lifetime as the reflected reactor at criticality. Several aspects of this phenomenon were examined, and the results of a number of previously reported experiments illustrating this effect were summarized. (auth)

28366 (NAA-SR-Memo-7253) VELOCITY DISTRIBUTION TESTS IN THE 6-1 AND 11-1 FUEL ELEMENT MODELS USING THE SALT VELOCITY TECHNIQUE. C. R. Davidson (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 19, 1962. Contract [AT(11-1)-Gen-8]. 18p.

Velocity distributions were obtained in the OMRE 6-1 fuel element model (banded and unbanded fuel bundles) and in the OMRE 11-1 fuel element model (unbanded fuel bundles) using the salt velocity technique in order to verify the results of previous air-flow tests. In general, the data confirmed the velocity distributions which were observed in the previous air-flow tests. However, the velocity distribution in the fin wall channels was more uniform in these tests. (auth)

28367 (NYO-10204) THEORY AND USE OF SMALL SUBCRITICAL ASSEMBLIES FOR THE MEASUREMENT OF REACTOR PARAMETERS. J. C. Peak, I. Kaplan, and T. J. Thompson (Massachusetts Inst. of Tech., Cambridge). Apr. 2, 1962. Contract AT(30-1)-2344. 178p. (MITNE-16)

The use of small subcritical assemblies for the measurement of reactor parameters in the preliminary study of new types of reactors was theoretically and experimentally investigated. Age-diffusion theory was applied to a cylindrical subcritical assembly with a thermal neutron source on one end. The solutions allow calculation of the thermal flux due to the source, the thermal flux due to neutrons born and moderated in the assembly, and the slowing down density at any particular age, for any point in the assembly. Methods of correction for source and leakage effects in small assemblies were developed for measurements of lattice parameters. Three dimensionless parameters were shown to characterize the size of an assembly in terms of its neutron behavior. Three other measures were advanced by which a proposed experimental position in a subcritical assembly could be evaluated. Tables illustrating the use of these parameters and measures are presented for 128 possible subcritical assemblies. The small assemblies were moderated with mixtures of light and heavy water. The following experimental measurements were made in each assembly:

axial and radial flux traverses with bare and cadmium covered gold foils, uranium-238 cadmium ratio in a rod, uranium-238 to uranium-235 fission ratio in a rod, and intracell flux traverses with bare and cadmium covered gold foils. The results are promising enough that further theoretical and experimental research on small subcritical assemblies is justified. (auth)

28368 (ORNL-3302) GAS-COOLED REACTOR PROGRAM QUARTERLY PROGRESS REPORT FOR PERIOD ENDING MARCH 31, 1962. (Oak Ridge National Lab., Tenn.). July 16, 1962. Contract W-7405-eng-26. 332p.

Progress on the gas-cooled reactor program is reported. Separate abstracts were prepared for each of the 14 sections. (M.C.G.)

28369 (ORNL-3302(p.3-18)) EGCR PERFORMANCE ANALYSES. (Oak Ridge National Lab., Tenn.).

Criticality studies were made of two abnormal conditions that were postulated to occur during the course of catastrophic accidents in the EGCR. In one case the fuel cladding and cluster supports were assumed to melt and allow the fuel to fall into the bottom of the fuel channels, and in the second case the support structure for the core was assumed to sag because of excessively high temperatures. Curves depicting the effects of these conditions on criticality were prepared. Calculations were made of the fuel element failures that may occur in the event of a depressurization accident based on new transient temperature curves supplied by Allis-Chalmers. The failures to be expected were determined as a function of scram delay time, fuel assembly location, and core group. The effects of operation of the EGCR emergency cooling system on graphite oxidation following the maximum credible accident were studied, since, in the event of rapid depressurization, air might be circulated in the primary system. The flow rate of the emergency cooling system is limited by reliability considerations and is not high enough to circulate sufficient air to prevent runaway oxidation; therefore chlorine suppression and diluent addition were evaluated as means for reducing the oxidation heat-generation rate. The studies indicated that chlorine suppression would not be adequate, and the possibility of reducing the air concentration by nitrogen purging is being considered. Oxidation rate factors were re-evaluated for additional calculations. (auth)

28370 (ORNL-3302(p.19-32)) STRUCTURAL INVESTIGATIONS. B. L. Greenstreet (Oak Ridge National Lab., Tenn.).

Data obtained by photoelastic analysis of a model of the EGCR pressure vessel are being compared with strain-gage data. The photoelastic analyses confirmed the conclusions of the strain-gage study that the maximun stresses are in the nozzles and that the design of the upper head of the pressure vessel is adequate for the design loading conditions. Revised calculations were made of the irradiation-induced shrinkage stresses to be expected in the EGCR graphite fuel sleeves based on a change in the type of graphite to be used and additional dimensional change data obtained from irradiation studies at Hanford. The maximum tensile stress was found to be about 75% of that previously determined. Investigations of the structural integrity of the EGCR through-tubes were completed. The data obtained show that the through-tubes will satisfactorily resist creep collapse during their design life. (auth)

28371 (ORNL-3302(p.33-45)) EGCR COMPONENT DEVELOPMENT AND TESTING. (Oak Ridge National Lab., Tenn.).

Additional flow tests were performed on the fuel channel top and bottom dummy assemblies. The objective of these tests is the determination of optimum bottom dummy orifice sizes and the optimum top dummy configuration. In decontamination studies, electrode potential measurements were found to be useful for determining the concentrations of hydrogen peroxide necessary to induce metal passivity in various oxalate-peroxide formulations and temperatures. A "fail-safe" oxalate-peroxide-citrate decontamination mixture with a life of about 12 hr at 95°C was developed. Acetate was also found to be suitable as a buffer in spray contact with carbon steel, since the spray contact inhibited the corrosion which would otherwise occur in the acetic acid vapor. Basic versene with triethanolamine was effective as a $Zr^{95}-Nb^{95}$ decontaminant. Light coatings of blue-black oxide on carbon steel were removed either with commercial phosphoric acid derusters or with a special two-step process using oxalate-peroxide. The design was completed and orders were placed for materials and parts for four instrumented fuel assemblies for the EGCR. It is necessary to use Pt–10% Rh vs Pt thermocouples for the first unit because stainless-steel-sheathed tungsten-alloy material was not obtained in sufficiently long lengths. The thermocouple diameter was increased to 0.0625 in. because of difficulties with 0.040-in.-dia. thermocouples in recent irradiation experiments. The effect on the indicated temperature of this increase in the size of the internal cladding thermocouple and the corresponding larger notch in the UO_2 pellets is being studied. Efforts to develop a reliable smaller diameter thermocouple are continuing. Components of the control-rod-drive testing facility are being assembled. In compressor and seal development studies, tests of a compressor for the control-rod-drive testing facility were completed, the progress in the production of the main EGCR coolant blowers and the pressure-vessel cooling-system compressors was reviewed, various types of compressors were evaluated for use in the EGCR emergency cooling loop, and a study was initiated of the effects of helium solubility on the operation of the seal cooling-water system and on the shaft seals for the rotating machinery. (auth)

28372 (ORNL-3302(p.46-56)) EGCR MATERIALS DEVELOPMENT. J. H. Coobs (Oak Ridge National Lab., Tenn.).

Compatibility studies of type 304 stainless steel with low pressures of CO and CO_2 in helium showed that carburization differences do not depend on heat-to-heat variations but are due mainly to section thickness. It was demonstrated that carburization does not increase systematically with the $(P_{CO})^2/P_{CO_2}$ ratio but reaches a maximum at a value of about 0.2. Increasing the CO content above this value uniformly decreases the extent of carburization. The results are concluded to be due to the retarding effect of oxide layers on carbon diffusion. Instrumented fuel capsules and test fuel elements were prepared for irradiation tests. A brazing furnace is being installed to permit faster heating and cooling cycles in the fabrication of such units. The faster cycles are needed to minimize grain growth in the cladding and make it consistent with EGCR grain-size considerations. An automatic bottom-end-cap welding device was developed for use in the fabrication of irradiation capsules and the EGCR instrumented fuel assemblies. In graphite-metal compatibility studies, data were obtained which showed that carbon transfer can occur at 1000°F in graphite-type 304 stainless steel couples when tested in a vacuum. Nonuniform loading of the specimen couples is believed to be the cause of anomalous results obtained from 1100°F tests. A method of obtaining a known uniform loading across the graphite-

erial interface must be devised. Tests at 1200°F for 1000 r and pressures of 1200, 2400, and 5100 psi indicated complete bonding at the two higher pressures and incomplete bonding at the lower pressure. (auth)

28373 (ORNL-3302(p.57-115)) IRRADIATION TESTING OF EGCR COMPONENTS AND MATERIALS. D. B. Trauger and O. Sisman (Oak Ridge National Lab., Tenn.).

Irradiation of group V capsules in continuing in the ORR poratide facility. The design and operating conditions were established for the group VI capsules. EGCR prototype-diameter capsule E-4 was removed from the ETR after achieving an estimated total burnup of 6188 Mwd/MT of UO_2. Irradiation of 12 capsules is continuing. Two prototype EGCR instrumented fuel elements were tested in GCR-ORR loop No. 1. It was found during these tests that 0.040-in.-o.d. thermocouples were not reliable, and therefore 0.060-or 0.080-in.-o.d. thermocouples will be used in future elements. Thermocouples of Pt–10% Rh vs Pt were found to be satisfactory for measuring central temperatures below 2800°F. Instrumented capsules 01C-4 and 08B-4, which were irradiated in the ORR, were examined. Cracks were found in brazed areas of capsule 01C-4, and the capsule had ballooned. It had bowed 0.015 in., and there were evidences of axial twist. All the UO_2 pellets had fractured. Capsule 08B-4 also leaked because of cladding failure. It had bowed 0.010 in., but there was no evidence of axial twist. All UO_2 pellets were cracked, and the central thermocouple well of Fansteel 82 was broken. Group IV capsules 02-4, 03-4, 06-4, and 07-4 are being examined. These capsules were designed to provide information on the effects of fission gas release on several samples of nonsintered UO_2 swaged and vibration-packed under various conditions. Test fuel elements 6A, and 7A, which were irradiated in GCR-ORR loop No. 1, are being examined. The elements are 19 in. long, 0.75 in. in diameter, and consist of hollow UO_2 pellets in stainless steel capsules. The elements performed satisfactorily during irradiation. Preliminary postirradiation measurements indicated slight bowing but no cladding failures or shifting of fuel. Examinations of capsule E-1A, which failed during irradiation in the ETR, revealed that the primary causes of failure were the formation of nitrides in the inner surface region of the stainless steel cladding and overheating of the UO_2. Fused and sintered UO_2 specimens were tested in instantaneous fission-gas-release experiments. Fission-gas release from the fused-crystal UO_2 showed a definite rate increase after about nine weeks of irradiation that could be attributed to breakup of the specimen with consequent increase in the surface area. Sintered UO_2 containing excess oxygen released bursts of fission gas when heated or cooled. Similar bursts of fission gas occurred when the fused-crystal specimen was heated, but there were no cooling bursts. There is evidence that the mechanisms of the heating and cooling bursts are different. The release of xenon and iodine were in the same steady-state ratios for both fused and sintered specimens and the activation energies of krypton, xenon, and iodine were the same. These results were not expected because the neutron fluxes were different by a factor of 10 and the structures of the specimens were different. Notch-impact and tensile test specimens are being fabricated for the EGCR pressure vessel surveillance program. The specimens will be subjected to various control and in-pile tests. (auth)

28374 (ORNL-3302(p.116-17)) EGCR EXPERIMENTAL FACILITIES. (Oak Ridge National Lab., Tenn.).

Fabrication of the EGCR experimental loop nozzle tees is under way. Work on the upper tees was heldup because of problems associated with the Stellite overlay processes. Loop piping subassemblies are being fabricated. The mechanical seals were ordered. Tests of a 1-in.-IPS hermetically sealed harmonic-drive glove valve were continued. Maintenance-free operation through 15000 cycles at 1050°F with an internal pressure of 1000 psig demonstrated a high degree of reliability. (auth)

28375 (ORNL-3302(p.121-30)) PBRE DESIGN AND DEVELOPMENT STUDIES. (Oak Ridge National Lab., Tenn.).

System and building layouts for the PBRE were studied in an effort to optimize the design and thereby reduce the cost. Steam systems with and without intermediate heat exchangers were found to have little cost difference. A primary system with a single horizontal gas-bearing compressor is being considered, along with a ventilation system that divides the containment building into a "clean" zone and a "hot" zone. A mockup of portions of the proposed fuel-handling system was constructed and operated satisfactorily. The mockup includes a pneumatic lift, a ball counter, a fuel element storage tray, a ball decelerator, and a device that unloads spheres from the storage tray in single file. A full-size test model of the rotating assembly for the main blower is being designed. A flywheel will be used to simulate the impeller, and an existing pressure vessel will be used for the tests. (auth)

28376 (ORNL-3302(p.131-47)) PBRE SYSTEM ANALYSES. (Oak Ridge National Lab., Tenn.).

Reactivity analyses were made of an equilibrium cycle. It was found that minimum costs for a full-scale reactor of the pebble-bed type would be obtained with fuel loadings of 5 to 7 wt % uranium plus thorium. The associated burnup would be 3.1×10^{19} fissions/cm^3 of fuel. On the basis of this analysis design values were established for the PBRE. Since the PBRE will be used for experiments and thus will not operate on an equilibrium cycle, these values provide only a basis for the design. A preliminary estimate of the temperature coefficient made by means of one-dimensional multigroup calculations (GNU code) gave a value of -1.6×10^{-5} ($\delta k/k$)/°F. Based on four B_4C control rods and a requirement of 0.10 δk initial excess reactivity, calculations indicate a shutdown margin of approximately 0.11 δk. Power distributions were computed for various positions of the control rods. A tentative conclusion was reached that the outer 4 in. of the reflector should include $\frac{1}{2}$ wt % boron to provide a reduction in the gamma heating of the pressure vessel, a reduction in shielding thickness, a reduction of the shield heat load, and a reduction of pressure vessel activation. Possible disadvantages are being evaluated. A structural analysis was made of the 48-in.-I.D. top access nozzle now considered necessary for removal of control rods. It was found that insulation would be required on the inner surface of the nozzle to assure structural integrity. The shrinkage stresses in the inner sleeves of the graphite reflector were evaluated in order to determine the expected lifetimes of the graphite cylinders before cracking. The lifetime values obtained for solid cylinders were less than desired, and therefore other configurations are being considered. Procedures were developed for estimating the temperature drop through spherical fuel elements in which the fueled portion is surrounded by an unfueled graphite shell. The total temperature drop for the case of zero gap thickness was approximately 4°F; for a xenon-filled gap between the shell and the fuel, the effect of the gap was negligible up to a thickness of 10 μ. Consideration was given to the use of a tapered core. It was found that the power density could be increased and the number of fuel balls decreased. (auth)

28377 (ORNL-3302(p.148-61)) HEAT TRANSFER AND FLUID FLOW IN PACKED-SPHERE BEDS. H. W. Hoffman (Oak Ridge National Lab., Tenn.).

An extensive examination of the technical literature with regard to the pressure loss associated with flow through randomly packed beds of spheres revealed a lack of agreement as to the functional form of the dependence of the friction factor on the Reynolds modulus and the void fraction. A critical evaluation of the available data led to the conclusion that the empirical equation $f = 75\ [(1-\epsilon)^2/\epsilon^3]\ (1/N_{Re})\ (U_m/U_s) + 0.875\ [(1-\epsilon)/\epsilon^3]\ (U_m/U_s)$, when decreased by the factor $1.86/N_{Re}^{0.1}$ to allow for wall effects in finite beds, is adequate (±25%) for predicting the friction factor over the complete range of PBRE interest. A full-scale model of the PBRE core region consisting of a Plexiglas vessel and unfueled graphite spheres was constructed. Preliminary results for the determination of void fraction, obtained by filling the model with known volumes of water and measuring the height attained, suggest an average axial value of 0.395. A study of the local thermal structure in the interior of packed-sphere beds was started. Because of its inherent simplicity, a mass-transfer technique using water-soluble benzoic acid spheres was selected. To provide a basis for interpreting later results for random beds and to establish the experimental procedure, initial experiments involved isolated spheres and single active spheres within regular packings. The isolated-sphere data were found to compare favorably with the results of other investigators on heat and mass transfer from single spheres; it was concluded that the technique of sphere preparation yielded reproducible surface properties and that the method of determining mass-transfer rates from dimensional changes was reliable. Preliminary measurements of the local variation in mass transfer from a sphere at the center of a cubic array yielded profiles which differed significantly from those observed for isolated spheres. A quantitative explanation based on reasonable conjectures as to the flow through a cubic array was advanced. It was established that the mass transfer was essentially zero at the contact points. An increase in the magnitude of the Sherwood modulus observed in the cubic-array experiment over that found with isolated spheres was ascribed to an increased turbulence level. (auth)

28378 (ORNL-3302(p.165-231)) FUELED-GRAPHITE INVESTIGATIONS. W. O. Harms, D. B. Trauger, O. Sisman, and G. M. Watson (Oak Ridge National Lab., Tenn.).

Studies were continued of the application of low-voltage radiography to the measurement of particle size and coating thickness of uranium carbide particles coated with pyrolytic graphite. Magnifications up to 500 were achieved with good resolution of the particle and coating images. Contact radiographs were made of 31 lots of coated particles using approximately 10-kvp x rays. Variations in particle size from uniform to a 3:1 ratio were observed. Particle shapes varied from spheroidal to very irregular, and multiple particles in a common coating were noted in about half the lots examined. Most of the lots examined showed some fuel migration into the coating, while about half the lots displayed high-density inclusions in the coatings that were presumed to be fuel compound. Coating thickness ratios within a given lot varied from 1.2:1 to 4:1. Unfueled carbon particles were found in six lots, while nine others contained similar particles contaminated with fuel compound. The properties of coated particles are being measured before irradiation for use in correlating the effects of irradiation. Materials supplied by commercial vendors have in general met a preliminary requirement for surface contamination of $\leq 5 \times 10^{-3}$% of the contained fuel. A nitric acid leach usually reduces the exposed fuel, as determined by surface alpha counting, while thermal cycling to 1500°C causes, in most samples, an increase in the alpha count and leachable fuel. The practicality of preparing contact radiographs of the coated particles was demonstrated. X rays were used in the recording of some details of the carbon coating. Examination at magnifications up to 500 gave qualitative information on fuel particle shape, coating thickness, and fuel diffusion into the coating. Neutron-activation tests were continued in order to determine the rates of fission-product release from uncoated UC_2 particles, coated particles, and fuel elements containing coated particles. Results for uncoated particles indicated markedly higher release rates from batches of particles not completely fused during fabrication. Tests at 1800 and 2000°C on uncoated particles showed that the rates of release of Ru^{103} and Nd^{147} are significant at these temperatures. A study of the relationship between high uranium losses from coated particles during acid leaching and high rates of Xe^{133} release showed that the correlation is somewhat questionable. The fission-gas retention properties of several coated particle fuel elements were found to be excellent in the as-received condition; however, preirradiation heat treatment for 20 hr at 1700°C prior to neutron activation was found to result in a marked increase in the release rate of Xe^{133} at 1000°C. This effect is thought to be due to uranium migration through the coatings. The performance of several binders and solvents in the fabrication of fueled graphite is being examined. Variations in loading during isostatic pressing of binder-graphite mixtures in collapsible rubber molds are being tried. Graphite densities >1.9 g/cm^3 were obtained after isostatically pressing at 35,000 psi. Cylindrical shapes warm molded at 800°C and 3200 psi had densities of approximately 1.7 g/cm^3. Pressure buildup by evolution of volatile material was partially controlled by using a porous carbon liner in a ribbed graphite die case. A few fueled-graphite cylinders were prepared using <5-μ UO_2 particles. Subsequent firing at 1800°C in hydrogen caused the fuel particles to convert to UC_2. Radiographs showed the fuel to be homogeneously distributed. Postirradiation examinations were made of capsules B9-6 and MTR-48-5. These capsules contained pyrolytic-carbon-coated uranium carbide particles dispersed in graphite. The graphite body of capsule B9-6 was coated with siliconized silicon carbide. The graphite body broke during irradiation at 2000°F to a burnup of 3000 Mwd/MT. The center of the specimen contained a loose mixture of coated particles and small graphite chunks. Approximately 3 to 5% of the coated particles were broken. Since air leaked into the helium sweep system during part of the irradiation, the loose material may have resulted from oxidation. The graphite container of assembly MTR-48-5, which was irradiated to a burnup of 17 at.% U^{235}, cracked because of swelling as a result of reaction with the tantalum thermocouple sheath. Dimensional measurements of the fuel cylinder showed small decreases in length and diameter. Metallographic examinations were made of LITR- and MTR-irradiated coated and uncoated uranium carbide particles. Instantaneous fission-gas-release experiments were run for comparing batch HTM-1 and batch 3M-SP-2 particles. The HTM particle coatings have a columnar structure and the 3M particle coatings have a laminar structure. The results for both types of particles showed that some of the coatings failed as soon as fission heating started, probably because of differential thermal expansion between the particle and the coating.

The particles with laminar coatings (3M) appeared to release fission gas with less holdup than the particles with columnar coatings. Further the gas release from the 3M particles was not temperature dependent, whereas the gas release from the HTM particles was highly temperature dependent. Additional capsules are being irradiated in the LITR, the MTR, and the ORR. The test system for studying high-temperature reactions of pyrolytic-carbon-coated carbide fuel particles and uncoated fuel bodies with water vapor in helium was completed. Final checks and preliminary studies are under way. The assembly consists primarily of a steam-generating device, a high-temperature reaction chamber, and a sampling system. The steam-generating device is being calibrated to determine the effluent water-in-helium concentration with respect to helium flow rate and generator batch temperature. The CO_2 generator of a test system for studying CO_2-graphite reactions is being calibrated with respect to bed temperature and helium flow rate. Carbon dioxide is generated by passing helium through a precisely controlled heated bed of $CaCO_3$. Samples of EBR-II graphite containing 3% B as B_4C, PR graphite containing 5% B as B_4C, and Speer 901-RYC graphite were degassed. The boronated graphite specimens were abnormal in their behavior above 1400°C in that they evolved very large volumes of nitrogen, perhaps as a result of the reaction $4BN_2 + C \rightarrow B_4C + 4N_2$. Work on the interdiffusion of two gases within porous media was extended to include, in addition to systems at uniform pressure, systems with pressure gradients and systems with temperature gradients. It now appears that it should be possible to develop an expression which will describe the thermal transpiration behavior over the entire transition region. (auth)

38379 (ORNL-3302(p.232-79)) CLAD FUEL DEVELOPMENT. (Oak Ridge National Lab., Tenn.).

Additional tube-burst data were obtained for type 304 stainless steel tested in air. These and previously obtained data were correlated with the Dorn parameter. The effects of heat treatments during fabrication on the room-temperature ductility of beryllium tubing are being studied. In room-temperature tube-burst tests conducted on short lengths of tubing from three vendors, tangential strains at fracture ranged from 0.184 to 0.55% for tubing machined from hot-pressed block and from 0.101 to 0.85% for hot-extruded tubing. The corrosion resistance of Be–0.5 wt % Ni alloys in static, dry CO_2 at 750°C was found to be pressure sensitive. The weight gain data showed the highest reaction rates at the lowest pressures. Barium may promote the formation of the carbonate layers which were reported to protect beryllium in the presence of moisture. Studies of the distribution of carbon in beryllium exposed to carbon dioxide were made with the use of C^{14} tracer to determine the location of the carbon. Small specimens of Pechiney Super Purity Flake material were suspended in a nonmetallic loop and heated in a CO_2 environment. All specimens tested to date have exhibited breakaway oxidation, probably because of water vapor in the system. The oxidation appears to follow inclusions in the starting material, indicating that some impurity may be influential in oxidation. Autoradiographs of the specimens indicate that the carbon is contained primarily in the surface reaction layer. Alternate polishing and surface counting of the specimens indicated qualitatively that the carbon was concentrated in the reaction film and primarily in the oxide. Work on the development of procedures for welding and brazing beryllium is continuing. Shear-strength tests were performed on end-closure welds at room temperature and at 600°C. The welds in all types of tubing exhibited similar strengths at each temperature. Methods were developed for direct extrusion of spirally finned beryllium tubing, and nondestructive evaluation tests were completed on 100 ft of the finned tubing. Metallographic examination of sections having eddy-current indications revealed inner surface pits and cracks. Low-voltage radiography was used to evaluate 22 tubing lengths. High-density material was found in the tube-wall root sections of 13 lengths, while 18 lengths displayed small, shallow pits. A simulated fuel element consisting of cored UO_2 pellets clad with finned beryllium was cycled 112 times between 482 and 1200°F. The capsule fractured circumferentially on the 67th cycle, and an axial crack was found after the test in the root section between two fins. The behavior of type 304 stainless steel tubing with wall thicknesses of 0.005 and 0.010 in. is being studied out of pile in a simulated fuel element thermal-cycling test. Elements were cycled between 350 and 1450°F with a 300-psi external pressure. The 0.010-in. tubing buckled axially on the 80th cycle. The 0.005-in. tubing collapsed into a gap which developed between adjacent fuel pellets and failed after 12 cycles. The plastic strain per cycle was significantly greater than that observed for 0.020-in. tubing tested under similar conditions. Exploratory studies of the $Mo-MoO_2-H_2-H_2O$ equilibria indicated that molybdenum will not be oxidized at temperatures above 1070°F in an atmosphere containing 10% water vapor if the active gas contains 90% H_2. Measurements of the thermal conductivity of UO_2 (93% theoretical density) were extended to 873°C in the radial heat-flow apparatus. An increase in the conductivity of a UO_2 specimen was observed in successive runs. This is thought to be due to a decrease in the oxygen-to-uranium ratio of the UO_2 that occurred concurrently. Several UO_2 powders were evaluated for making controlled-grain-size specimens. A foreign phase, identified as alpha-iron, was found, however, and work was suspended until higher purity material can be obtained. A technique was developed for BeO fabrication that permits control of grain size and density in the range of 90 to 97% of theoretical and was used for the successful preparation of approximately 550 unfueled BeO specimens. A program for evaluating the irradiation performance of fueled BeO was developed. Several methods based on the attrition of irregular particles of low strength were examined for preparation of spherical UO_2 particles for use as the fuel. The removal of fines during the spheroidizing process by a novel method which employs a tubular track and a high-velocity air stream resulted in an improved product. Comparative tests are being made to determine the best source of $(Th,U)O_2$ solid-solution material. The starting materials being considered are mechanical mixtures, coprecipitated oxide, and sol-gel oxide. Data obtained in the first five BeO-irradiation experiments were evaluated, and the greatest damage was found in bodies irradiated to high neutron doses at low temperatures. Helium and tritium concentrations in the specimens could be correlated with exposure. Lattice damage could be annealed at temperatures in the range 700 to 1050°C. Experimental assembly ORNL-41-6 is being examined and assembly 41-7 is being irradiated. Examinations of $BeO-UO_2$ and $BeO-UO_2-ThO_2$ specimens that were irradiated in the LITR indicated fission fragment damage to the BeO crystal structure. There was no evidence of grain structure in small UO_2 particles, but grains were evident in the larger pieces. Examinations were completed of irradiated bulk UC pellets. Fission-gas release from UC appears to be considerably higher than that from UO_2 at similar temperatures. Irradiated beryllium-clad UO_2-fueled capsules with

MgO-end spacers were examined. No evidence of reactions at the UO_2–Be, UO_2–MgO, or MgO–Be interfaces was found. A final beryllium irradiation experiment was started. The specimens are being irradiated at 430°C, and irradiation will be continued to a fast-neutron (>1 Mev) exposure of 10^{21} neutrons/cm^2. Twelve swelling specimens are being irradiated at temperatures of 550 to 675°C to the same neutron exposure to determine the effect of composition and specimen fabrication history. Eight Inconel tube-burst specimens were tested in the ORR poolside facility in air at 1500°F and at stress levels of 3000, 4000, and 5000 psi. Comparison of the data obtained out of pile showed that irradiation at a fast-neutron (>0.7 Mev) flux of 5×10^{13} neutrons/cm^2 sec did not produce an observable change in the creep rate. Ten stainless steel stress-rupture specimens were irradiated and are in a hot cell for examination. Metallographic examinations of previously irradiated stainless steel specimens showed large quantities of precipitate, probably chromium nitride, that was evidently caused by reaction with the air used as the pressurizing gas. (auth)

28380 (ORNL-3302(p.280-300)) DESIGN STUDIES OF ADVANCED SYSTEMS. (Oak Ridge National Lab., Tenn.).

A helium-cooled reactor power plant that will use clad fuel and will have an electrical output of 750 Mw is being designed. The reactor, designated GCR-3 brings up to date the technology previously embodied in the GCR-2 study completed in 1958. A parametric study was made of the thermal performance of a core of the type proposed. Curves were prepared to present the data obtained in this study. Calculations based on the preliminary layout of the GCR-3 showed that natural convection would be adequate for afterheat removal. Reactivity limitations on fuel exposure and the resulting fuel cycle costs were studied as functions of lattice pitch and enrichment. No practical limitations on attainable lifetime were found and it may be that metallurgical limitations will prevail. Blowers and drives for the GCR-3 were designed. The blowers are of the axial-flow type and use seven aerodynamic stages. (auth)

28381 (ORNL-3302(p.301-16)) EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER AND FLUID FLOW. H. W. Hoffman (Oak Ridge National Lab., Tenn.).

The investigation of the thermal characteristics of EGCR-type clusters in a channel containing two full-scale, electrically heated models was continued. The following conditions were considered: uniform heating in upper cluster only, both clusters uniformly heated, upper cluster only heated with central-tube power reduced, and both clusters heated with central-tube power reduced. Only the in-line orientation of tubes and spiders was examined. After correction of an inadvertent error introduced during analysis of the data obtained with only the upper cluster heated, the maximum deviation in average tube-surface temperatures at any level was found to be 4°F. Discrepancies between typical circumferential temperature profiles were ascribed to effects of spider ribs. With both clusters uniformly heated, the variation in mean surface temperatures between tubes increased to 8°F in the exit half of the second cluster; this was believed to result, in part, from increased difficulties in power control for the two-heated-cluster situation. Interpretation of the circumferential temperature profiles suggested that a form of "hot-streaking" existed, with the end spiders effecting (through mixing) little equalization in temperature of the gas flowing in the inner and outer flow regions of the channel. The effect of reduced central-tube power on either the axial-mean or circumferential temperature distributions was found to be small for both the one- and two-heated-cluster situations. The presence of the cooler central tube and the somewhat decreased total heat input resulted in lower minimum surface temperatures and in smaller temperature differences between the 0-deg and minimum circumferential locations than was observed with uniformly heated clusters. These changes were apparent only with both clusters heated. A detailed examination of the axial variation in the tube-surface temperature was made in the vicinity of the mid-cluster spacer; the results were consistent with the more data obtained previously. The thermal gradient was of the order of 35°F/in. Adjusted values of the Nusselt modulus at the exit end of the test cluster differed between experiments by less than 3%. No significant effect of nonuniform inlet gas temperature was observed. A comparison of these data with a correlation developed from earlier experiments showed a disagreement of less than 11%. The influence of "roughened" surfaces on the pressure drop in EGCR clusters was examined. A graphite channel containing three full-scale clusters with tubes wrapped with 0.006-in.-dia. wire at a 0.060-in. pitch was utilized for this study. It was observed that the Blasius friction factor at $N_{Re} = 50{,}000$ was approximately three times greater than the value associated with flow in smooth tubes and corresponded closely to the Nikuradse curve for surfaces having a ratio of tube-radius to roughness height of 15. In this experiment, the roughness ratio, based on equivalent channel diameter and twice the wire diameter, was 50; thus, the data fall significantly above the predicted values. The form drag associated with the mid-cluster spacers and the end spiders was somewhat less than previously observed in the smooth-tube experiments; it is suggested, in analogy with results for a single sphere with a tripping wire on its surface, that the wires influence the boundary-layer flow on the surface of the spiders and spacers sufficiently to effect early transition to the low-drag condition. (auth)

28382 (ORNL-3302(p.317-27)) FACILITIES AND EQUIPMENT. (Oak Ridge National Lab., Tenn.).

Work continued on construction of GCR-ORR loop No. 2. The main piping runs and associated equipment were installed and helium leak checked. Leak checks of other components are under way. All flow diagrams were brought up to date. Two of the three gas-bearing compressors ordered for GCR-ORR loop No. 2 were received and the third is being tested by the manufacturer. These units will be tested further at ORNL. Additional operating time was accumulated for an experimental gas-bearing compressor being tested at ORNL. Satisfactory operation was achieved at higher speeds, higher depressurization rates, and lower pressures than expected. Tests were started for determining the magnitude and frequency range of forced vibrations within which the compressor can successfully operate. A chromatograph is being adapted for analyzing gaseous samples derived from studies of the reaction kinetics of gases with graphite. A comparison of this instrument with the Greenbrier chromatograph revealed an advantage only in the determination of hydrogen, for which the sensitivity is increased about fivefold. Emf profile measurements of wires and sheaths of type 304 stainless steel-sheathed Chromel-P vs Alumel thermocouples revealed the development of inhomogeneities during test exposures. Thermocouples exposed at 870°C to hydrogen at 7 psig showed extreme damage to the Chromel-P wire that resulted in emf drift during the test. Exposure at 870°C to hydrogen at 150 psig did not cause changes in either wire. Changes in both Alumel and Chromel-P occurred during exposure at 870°C to CO at 7 psig; however, these inhomogeneities did not result in appreciable emf drift during testing in CO at 7 psig. Negative emf drifts averaging about 10 to 20°C occurred

with tungsten vs tungsten–26% rhenium thermocouples in a graphite resistance furnace at 1700°C for 100 to 200 hr in a purified helium atmosphere. Analyses showed that the surface rhenium content of this wire was higher than the nominal value at the start of the test and may have decreased during the test. Tungsten–26% rhenium alloy wires tested with the thermocouples were stable in emf output during the test. (auth)

28383 (TID-7631) ROTATING MACHINERY FOR GAS-COOLED REACTOR APPLICATION. Proceedings of Meeting at Oak Ridge National Laboratory, April 2-4, 1962. (Oak Ridge National Lab., Tenn.). 409p.

A total of 30 papers are included in the cumulation. Separate abstracts were prepared for 29 papers. No abstract was prepared for a single presentation concerned with the performance characteristics of a centrifugal compressor for He at 1000°F and 250 psig. (J.R.D.)

28384 (TID-7631(p.1-14)) EGCR MAIN COOLANT BLOWERS AND VESSEL-COOLING COMPRESSORS. E. R. Taylor (Oak Ridge National Lab., Tenn.).

A general discussion of the EGCR design is presented with emphasis on the main coolant blowers and vessel-cooling compressors. The full-load design mass-flow of the two main coolant compressors is 215,000 lb/hr He per blower; other design conditions for normal operation are also given. The two vessel cooling compressors are designed to provide continuous He flow to the reactor vessel and top nozzles, and to provide intermittent cooling to the charge and service machines. Each compressor is designed to provide maximum flow of 23,000 lb/hr He. Other design data are included. (J.R.D.)

28385 (TID-7631(p.15-25)) SHAFT SEALS FOR THE EGCR REACTOR. W. F. Boudreau and E. R. Taylor (Oak Ridge National Lab., Tenn.).

A design description of the EGCR shaft seals is presented. Specifications for He leakage from the EGCR cooling system limit the loss to 1%/day. Expressed in terms of normal He inventory, the maximum rate is equivalent to the loss of 13.5 lb/day. It was anticipated that part of this loss would occur through reactor vessel static seals, and it was deemed advisable to limit the leakage through shaft seals to the lowest possible value. The discussion is devoted to a description of the floating-bushing seal, buffering and He removal systems, gas-transfer paths, back-diffusion, predicted operating parameters, and seal area configuration. (J.R.D.)

28386 (TID-7631(p.26-32)) DESCRIPTION AND OPERATIONAL ASPECTS OF MAIN HELIUM CIRCULATORS FOR THE 40-MW(e) HTGR PLANT. P. H. Monroe (General Atomic Div. General Dynamics Corp., San Diego, Calif.).

A general description including operational aspects of the main gas coolant circulators is presented for the 40-MW(e) HTGR plant. Included are discussions of the main coolant system, circulators, shaft and seal system, drivers, lube system, and operation. (J.R.D.)

28387 (TID-7631(p.33-9)) HELIUM COMPRESSOR FOR A 40 MW(e) HIGH TEMPERATURE GAS-COOLED REACTOR. H. O. Jacobi (Clark Bros. Co. Div. of Dresser Industries, Inc., Olean, N. Y.).

Design of the compressors for use in the two He coolant loops in the HTGR is discussed. A centrifugal compressor was selected on the basis of simplicity, smooth configuration, and reliability in comparison with the axial flow type. The compressor construction features are described including the casing, pedestal, impeller, shaft, and seals and bearings. (J.R.D.)

28388 (TID-7631(p.40-5)) SHAFT SEAL DEVELOPMENT PROGRAM FOR THE HTGR. R. Dunn (Clark Bros. Co. Div. of Dresser Industries, Inc., Olean, N. Y.).

Development of the shaft seal for the HTGR recirculator is reviewed. An interlocking labyrinth was developed which is installed on the shaft from the drive end. This type labyrinth provides a lower leakage rate than straight or stepped labyrinths for a specified shaft size. The stationary labyrinths are fastened in position by bolts. Leakage around the outside is prevented by gaskets and a piston ring. Other design aspects are discussed and diagrams of the seal system are included. (J.R.D.)

28389 (TID-7631(p.46-61)) THE GCR-3 HELIUM BLOWERS. Paul A. Berman (Westinghouse Electric Corp. Small Steam and Gas Turbine Div., Lester, Penna.).

The preliminary design of the blowers for GCR-3 is described. The blowers are designed to circulate He at a rate of 248,000 cfm when four primary loops are used. At the normal operating point of the blower a pressure rise of 24.3 psi is developed. However, the blade path is designed for a pressure rise of 27.5 psi providing for a 25% stall margin. The entire rotating assembly may be removed from the blower housing containing the main gas piping by breaking one casing flange and external bearing lube and seal lines. This will permit complete changeover of the blower element in a minimum of down time, by remote handling, if necessary. The blower, rated at 3720 rpm, has seven repeating states of constant height. Free vortex radial equilibrium was used with a symmetric velocity triangle at the mean blade height in the blade path design. (auth)

28390 (TID-7631(p.62-71)) THE RESULTS OF A PARAMETRIC STUDY OF THE THERMAL STRESSES IN CYLINDRICAL SHELLS. F. J. Stanek (Oak Ridge National Lab., Tenn.).

The results of a study for determining the influence of the temperature parameters on the theoretical thermal stresses in a cylindrical shell are presented. The results were obtained with the use of modifications of two of the basic cylindrical shell formulas. The study was initiated specifically for cylindrical shells which were being designed for use as housings for gas-bearing compressors for the experimental loops in the Experimental Gas-Cooled Reactor and the Oak Ridge Research Reactor; however, the results can be applied to a cylindrical shell of any size since all the results are presented in dimensionless plots. These dimensionless plots can be readily converted to actual physical values by merely multiplying each coordinate by an appropriate factor. A formula is also given for the calculation of the maximum thermal stress for a specific case where one of the temperature parameters is zero and the other parameter is of infinite length. (auth)

28391 (TID-7631(p.72-5)) APPLICATION OF CODES TO BLOWER CASINGS. R. W. Schneider (Oak Ridge National Lab., Tenn.).

In a discussion of the general treatment of blower casings, it is noted that in a nuclear system, such cases must have the same integrity as any other critical item comprising a system part. Sections of the ASME codes providing for design of boilers and pressure vessels are discussed. Other discussion concerns the responsibility of the purchaser and the trend in future codes. (J.R.D.)

28392 (TID-7631(p.76-84)) DETERMINATION OF BACK-DIFFUSION RATES IN THE MSRE FUEL PUMP USING RADIOACTIVE KRYPTON-85 AS A TRACER GAS. C. H. Gabbard (Oak Ridge National Lab., Tenn.).

An experiment to determine whether back diffusion of

fission products occurs in the lubrication system of the MRSE fused-salt circulating pump is described. A sweep gas system is used to limit the migration of fission gas to the oil catch basin in this system. Exposure of the oil to excess radiation causes polymerization and hardening. On the basis of an oil residence time in the catch basin of 24 hr and the fact that a dose of 10^7 rad can be tolerated before significant changes occur in the oil viscosity, a preliminary calculation indicated that a reduction of the fission gas concentration by a factor of 15,000 was required between the pump tank and oil catch-basin to avoid excessive radiation damage to the leakage oil. The back diffusion experiment was designed to detect concentration differences of this magnitude using Kr^{85} as tracer gas. (J.R.D.)

28393 (TID-7631(p.85-103)) A RESEARCH PROGRAM ON DYNAMIC SEALS. William K. Stair (Tennessee. Univ., Knoxville. Engineering Experiment Station).

A program outline for investigation of dynamic seals is described. Work at the Univ. of Tenn. is discussed and results of a literature survey are presented. Comment is included on the state-of-the-art in labyrinth seals, buffered bushing seals, mechanical face seals, and visco seals. (J.R.D.)

28394 (TID-7631(p.104-15)) STATUS REPORT ON DEVELOPMENT OF MGCR TURBOMACHINERY. W. T. Furgerson (General Atomic Div. General Dynamics Corp., San Diego, Calif.). (GA-3060)

Activities in a program to establish conceptual design of the rotating machinery for use in MGCR and to develop it to a point where detail design and construction can be started are described. The development was conducted in areas such as compressor and turbine blade-path studies, inlet and discharge ducting tests, development of shaft seals and lubrication system, and metallurgical work. Results of development work indicate that all assumed values can be achieved and in some cases these are conservative. (J.R.D.)

28395 (TID-7631(p.116-32)) ML-1 POWER CONVERSION SYSTEM. Charles M. Rice (Aerojet-General Corp., Azusa, Calif.).

Design criteria for the ML-1 power conversion system is presented. Data and other information are included on power output, power plant general description, the reactor, the precooler, the recuperator, turbine-compressor sets, and the lube and seal system. Information is also included on the power conversion skid closed-cycle tests. (J.R.D.)

28396 (TID-7631(p.133-44)) THE ML-1 TURBINE COMPRESSOR SET. O. C. Schoeppner (Clark Bros. Co. Div. of Dresser Industries, Inc., Olean, N. Y.).

Design and operational aspects of the ML-1 turbine compressor set (T-C set) are discussed. Included are descriptions concerning the T-C set, performance of the T-C set, and discussions of compressor aerodynamics, turbine aerodynamics, and open and closed cycle testing. (J.R.D.)

28397 (TID-7631(p.169-80)) BOOT STRAP CIRCULATOR FOR GAS-COOLED REACTORS. Jack Yampolsky (Fairchild Stratos Corp. Stratos Div., Bay Shore, N. Y.).

A conceptual design for the circulating system for gas-cooled reactors which minimizes large power requirements, does not add to the contamination, is reliable, and has long operating life is presented. The arrangement allows for the use of the Brayton Cycle in the circulation system. Mechanical aspects of the system are discussed and data on compressor design are included. (J.R.D.)

28398 (TID-7631(p.181-200)) PRTR OPERATING EXPERIENCE WITH DIAPHRAGM-TYPE HELIUM COMPRESSORS. D. J. Foley and L. D. Gustafson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The diaphragm-type compressors used to provide a constant supply of high-pressure He to pressurize the PRTR primary system are described. This type of compressor was chosen because it requires no dynamic gas seals and does not require the constant removal of lubricating oil. The benefits of such equipment are gained at the expense of equipment simplicity; continuous attention and routine maintenance are required. (J.R.D.)

28399 (TID-7631(p.201-13)) OPERATING EXPERIENCE WITH DIAPHRAGM-TYPE COMPRESSOR IN HELIUM SERVICE. R. D. Haynes (Bureau of Mines. Helium Research Center, Amarillo, Tex.).

Compression of Grade-A He from 2600 to 4000 psig without contamination was achieved by using a metal diaphragm compressor. Failure of the metal diaphragms can be reduced by installing a filter on the suction line to eliminate foreign particles which may puncture or otherwise cause failure of the diaphragms. Replacing diaphragm sets every 500 hr of operating provides a reasonable service life from the diaphragms and essentially eliminates the possibility of oil being pumped through a fracture in the diaphragm set to contaminate the Grade-A He and the discharge line. Diaphragm-set failure can be detected by periodically observing the rate of flow from the compressor. At the first sign of reduced flow, the compressor should be shut down to minimize the possibility of oil contamination in the discharge line. Experience showed that prompt action can prevent any oil from being pumped into the discharge line. (auth)

28400 (TID-7631(p.215-27)) THE PERFORMANCE OF GREASE-LUBRICATED BALL BEARINGS IN SMALL COMPRESSORS. I. K. Namba (Oak Ridge National Lab., Tenn.).

Two-year operating experience with small hermetically sealed motor-driven compressors of the centrifugal and regenerative types, equipped with grease-lubricated ball bearings is discussed. The temperatures of the bearings in these compressors were below 200°F. Tests were also conducted at bearing temperatures of 250 to 300°F. It was found that grease-lubricated ball bearings in the series 107 and 205 sizes can be operated in He and Ar atmospheres for at least 3000 hr without relubrication at DN values up to 450,000 provided the temperature of the bearings is maintained at 200°F or less. A lubricant for use at 250 to 300°F was not found. (J.R.D.)

28401 (TID-7631(p.228-42)) REVIEW OF REGENERATIVE COMPRESSOR THEORY. D. W. Burton (Oak Ridge Gaseous Diffusion Plant, Tenn.).

The regenerative compressor is also referred to as peripheral, fraction, vortex, drag, friction, turbine, side channel, and tangential. This type of turbomachine was used in applications in which high delivery heads and low volume flows are desired; a contemplated use is in a plant for separation of gaseous isotopes with speeds of sound in the 300- to 600-ft/sec range. Theories discussed include those concerned with momentum exchange, turbulent-flow, head-flow, and compressible-flow. (J.R.D.)

28402 (TID-7631(p.243-51)) THERMAL ANALYSIS OF A SMALL REGENERATIVE COMPRESSOR. D. L. Gray (Oak Ridge National Lab., Tenn.).

A design was proposed for a small, self-contained, He-cooled in-pile loop for evaluating the deposition of fission

products from unclad fuel elements under temperature and gas flow conditions approximating the design requirements for a pebble-bed power reactor. The loop was envisioned as a relatively inexpensive self-contained unit which could easily be transported to a hot cell for disassembly. A need was foreseen for a low-cost compressor capable of delivering 20 ft^3 of He/min with a rise in head of 1000 ft, at suction conditions of 310 psia and 550°F. The compressor was to have a minimum operational life of 1000 hr. It was required that the removal of heat from the motor, motor housing, and bearings be accomplished solely by heat flow through the stainless steel primary containment vessel, across the He-filled gap between the primary and secondary containment vessels, and through the stainless steel secondary containment vessel to water (at 100°F) surrounding the outside of the secondary vessel. Results of thermal analysis indicated that the proposed compressor was capable of restricting heat flow to the bearings and conducting heat from the motor housing to the extent that the compressor environmental ambient temperature could be held to less than 250°F. The bearing temperatures were predicted with an accuracy of 10% for the rear bearing and 4% for the forward bearing (based on the Fahrenheit scale), and both predicted temperatures were on the safe side from the operational standpoint. (J.R.D.)

28403 (TID-7631(p.252-5)) BLOWER REQUIREMENTS FOR THE ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT. W. E. Crowe (Los Alamos Scientific Lab., N. Mex.).

Construction of the facility for the Ultra High Temperature Reactor Experiment (UHTREX) was scheduled to start in June 1962, with reactor operation to begin in late 1964. In this experiment, the use of simple unclad fuel in a gas-cooled reactor at gas temperatures up to 2400°F will be investigated. The 3 Mw(t) reactor will be cooled with a He loop operating at a maximum pressure of 500 psia and a flow rate of 10,250 lb/hr. Volatile fission products will circulate freely in this primary loop. He leaves the reactor at 2400°F and is cooled first by the heat recuperator to 1600°F and then by the heat exchanger to 600°F. Leaving the heat exchanger, the gas goes through a He blower to the return side of the heat recuperator where the temperature is raised to 1600°F as the gas goes back into the reactor and the primary loop is closed. The primary loop is cooled by the secondary He loop where the temperature is raised from 200 to 1000°F in the heat exchanger and this heat is removed in an atmospheric heat dump; another blower returns the gas to the heat exchanger and the secondary loop is closed. Approximately 1% of the primary loop He flow is directed through the gas clean-up loop where fission products and other impurities are removed. Two blowers will be installed in the primary loop with manually operated isolation valves so that only one blower may be used at a time. One blower will be installed in the secondary loop and a small blower will be installed in the gas clean-up loop. Blowers in primary and secondary loops can be of identical design so that the number of required spares is minimized. The blowers for UHTREX need to be highly reliable, leak tight, and capable of running for several thousand hours without maintenance. Blower systems which add contaminants to the loop would not be acceptable. Hydrodynamic gas bearings in a canned unit offer the most promising vehicle for the accomplishment of LASL objectives. (J.R.D.)

28404 (TID-7631(p.256-69)) OPERATING EXPERIENCE WITH GAS BEARING CIRCULATORS IN AN IN-REACTOR TEST LOOP. E. C. Bennett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (HW-SA-2464)

Operating experience in the DR-1 gas loop used for testing gas-cooled reactor fuel elements is described. A review of the main loop components and the operating characteristics that are pertinent to gas seal problems is presented. It is noted that the facility presents three major gas seal problems including loop coolant losses, radioactive materials containment, and contamination of the coolant from sources external to the loop. These problems are associated with auxiliary equipment for the circulators. The circulators are dependable and the gas-lubricated bearings are considered a practical solution for shaft seal problems in gas loops. Development of self-acting bearings is recommended. (J.R.D.)

28405 (TID-7631(p.270-9)) PERFORMANCE OF A GAS-BEARING COMPRESSOR IN THE GENERAL ATOMIC HTGR IN-PILE LOOP. R. Stella (General Atomic Div. General Dynamics Corp., San Diego, Calif.).

Operation of parallel-connected compressors for the HTGR in-pile loop is described. During normal operation, only one compressor is running; the second is an on-line spare. The compressors operate at temperatures up to 640°F. A total of three compressors were purchased and loop tested. A gas bearing in each compressor failed. The operating history of each machine is discussed and presented tabularly. (J.R.D.)

28406 (TID-7631(p.280-91)) OPERATING CHARACTERISTICS OF GAS-BEARING COMPRESSORS BUILT BY BRISTOL SIDDELEY ENGINES, LTD. D. L. Gray (Oak Ridge National Lab., Tenn.).

Tests of two similar but slightly different gas-bearing compressors are described. The single model of one type compressor was operated under a variety of conditions for about 760 hr since it was installed in the ORNL test loop. The test equipment and test results associated with this compressor are described. Two models of the other type compressor were tested at the manufacturer's plant. Over 100 hr of satisfactory service was accumulated with these compressors. Equipment and results associated with these tests are also presented. (J.R.D.)

28407 (TID-7631(p.292-306)) GAS-BEARING DEVELOPMENT AT THE SOCIETE RATEAU (FRANCE). J. S. Chaboseau and C. Mech (Société Rateau, La Courneuve, France).

Development of the gas-bearing technique used in the Marcoule reactors is described. Included are discussions of cylindrical bearings and multi-pad bearings. Experience with existing bearings operating with gases such as UF_6, CO_2, and He is also reported. (J.R.D.)

28408 (TID-7631(p.307-34)) PROGRESS REPORT ON THE DEVELOPMENT OF GAS-LUBRICATED BEARINGS FOR HIGH-SPEED ROTATING MACHINERY. M. W. Eusepi and D. D. Fuller (Franklin Inst. Labs. for Research and Development, Philadelphia).

Activities and results associated with the first year's program at the Franklin Institute Laboratories on gas-lubricated bearings are summarized. The program was directed along two parallel avenues. One investigation was concerned with the characteristics of a 3-in. dia. rotor weighing 100 lb used to simulate the shaft of a turbine-compressor unit. The other effort was concerned with a rotor shaft that is to be supported on bearings which are completely self acting rather than externally pressurized. (J.R.D.)

28409 (TID-7631(p.335-43)) A HIGH-TEMPERATURE MOTOR TEST UNIT UTILIZING GAS BEARINGS. Justin Cherubim and Stanley Abramovitz (Continental Bearing Research Corp., New York).

Activities in a program to develop circulators with gas-lubricated bearings for use in gas-cooled reactors are described. The objective is to achieve continuous operation in He at 400 psia and 800 to 1000°F. A circulator was designed and tested at 12,000 to 18,000 rpm at gas pressures of 60 to 200 psi and 150°F using tilting pad bearings with a vertically mounted circulator. (J.R.D.)

28410 (TID-7631(p.344-60)) GAS BEARING STATE OF THE ART. Beno Sternlicht (Mechanical Technology Inc., Latham, N. Y.).

The state-of-the-art appraisal includes detailed examinations of gas-lubricated bearing advantages and problem areas, terminology definitions, and bearing classification by mechanisms which generate load-carrying capacity. Also included are design information on steady state and dynamic performance, and a review of current knowledge concerning steady state operations, dynamic operations, and materials. (J.R.D.)

28411 (TID-7631(p.361-96)) ON STABILITY OF ROTORS SUPPORTED BY GAS BEARINGS. B. Sternlicht (Mechanical Technology Inc., Latham, N. Y.).

Experimental results are presented for plain cylindrical and axial groove gas journal bearings and they are compared with the available theory. These results represent several years of experimental work. The measured initial disturbance and onset of half frequency whirl (hfw) are reported for a variety of conditions. The effect of load, mass, L/D, and clearance on the threshold of instability for plain cylindrical journal bearings are shown and compared with theory. The threshold of instability as a function of groove location, number of grooves and orifices, etc. is also discussed. It is reasonably well known that grooves reduce the hydrodynamic load-carrying capacity. Theoretical analyses are included which give load carrying capacity as a function of groove location. (auth)

28412 (TID-7631(p.397-402)) PROCEEDING DEVELOPMENTS ON GAS-BEARING AT SOCIETE RATEAU (FRANCE). J. S. Chaboseau (Société Rateau, La Courneuve, France).

Activities in a basic research program to determine working principles of tilting pad gas-bearings are described. Included is a review of geometrical pad-parameters, physical parameters, and mechanical parameters which affect hydrodynamic operation. It is believed that gas bearings present the possibility of building very reliable machines which are easily operated and maintained. (J.R.D.)

28413 (TID-16220) SPATIALLY DEPENDENT SPECTRA AT ENERGIES ABOVE THERMAL. F. D. Federighi and P. A. Ombrellaro (Knolls Atomic Power Lab., Schenectady, N. Y.). [nd]. Contract W-31-109-eng-52. 8p.

The use of linear combinations of infinite medium spectra in predicting spatially dependent spectra at energies above thermal is discussed. The validity of this procedure is demonstrated by an example. (M.C.G.)

28414 (TID-16321) A NUCLEAR REACTOR SAFETY ROD COUNTING SYSTEM USING THE DIRECT-CURRENT BRIDGE PRINCIPLE (thesis). Melvin Lewis Faught (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 1961. Contract AT(45-1)-1350. 41p.

Submitted to University of Idaho, Moscow.

A general description is presented concerning the complete interconnection between the first and third safety systems for use in high-energy reactors. Development of a component to achieve the desired interconnecting logic is also described. This component is based on an event-counting concept appearing as a Wheatstone bridge network which utilizes a sensitive polarized relay as the bridge detector. Included are design criteria for the bridge components, component selection, component tolerance, and construction and application of the bridge. A second type of rod-counting system is also described for safety back-up. (J.R.D.)

28415 (WAPD-BT-25) BETTIS TECHNICAL REVIEW. REACTOR TECHNOLOGY. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1962. Contract AT(11-1)-Gen-14. 107p.

A total of eight papers is included, for seven of which separate abstracts were prepared. (J.R.D.)

28416 (WAPD-BT-25(1-24)) THE DESCRIPTION OF THE THERMAL NEUTRON SPATIALLY DEPENDENT SPECTRUM BY MEANS OF VARIATIONAL PRINCIPLES. A. J. Buslik (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

The application of the calculus of variations to the determination of the thermal neutron space and energy distribution is described, and it is shown how thin absorbing regions treated by blackness theory can be included in the method. The general method is then applied to the problem of an absorber adjacent to a large fuel bearing region. Results are compared with the 36 multigroup solution of the thermal space energy problem by the digital computer code SLOP-1. In addition, a manner of incorporating these results into a one-group design method is presented. (auth)

28417 (WAPD-BT-25(p.27-35)) THE $O^{16}(n,p)N^{16}$ REACTION CROSS SECTION. K. Shure (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

A review was made of the available information concerning the cross section of the $O^{16}(n,p)N^{16}$ reaction with regard to application to water-cooled reactors. Recent measurements of the excitation function for this reaction, with good precision, have covered a wider energy range than heretofore. This excitation function, when averaged over the fission neutron spectrum, agrees to within experimental uncertainties with the result of an integral activation meansurement of 21 ± 4 μb for N^{16} production with a yield of 0.74 high-energy gamma rays per disintegration. (auth)

28418 (WAPD-BT-25(p.37-45)) AN EXPERIMENTAL STUDY OF HYDRAULICALLY INDUCED MOTION IN FLAT PLATE ASSEMBLIES. R. J. Scavuzzo (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Earlier investigations predicted certain collapse velocity values at which motion would be induced in flexible plates subjected to high-velocity reactor coolant flow. The present program, employing direct measuring techniques, demonstrated that plate motion occurred at values much less than the theoretical collapse velocity. In addition, plate deflection was found to be dependent upon initial plate deflection, the coolant channel velocity, and the geometric design parameters. (auth)

28419 (WAPD-BT-25(p.47-72)) A MOMENTUM INTEGRAL MODEL FOR THE TREATMENT OF TRANSIENT FLUID FLOW. J. E. Mayer and J. S. Williams, Jr. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

A description is given of a method for handling one-dimensional, two-phase hydrodynamics in a single, plate-enclosed reactor coolant channel. The coolant conditions range from subcooled water through a steam-water mixture up to, and including, superheated steam. Heat transfer may be forced convection, nucleate boiling, transition boiling, or film boiling. Fluid expansion effects are included and the transient is forced by specifying, as a function of time, heat generation rate, inlet enthalpy, and either inlet mass velocity or total channel pressure drop. (auth)

3439 (WAPD-BT-25(p.73-86)) A CORROSION EVALUATION OF THE EFFECTS OF THE CITRIC ACID—DISODIUM EDTA DECONTAMINATION PROCESS ON PLANT STRUCTURAL MATERIALS WITH AND WITHOUT ULTRASONICS TREATMENT. R. E. Moore (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

A citric acid solution containing disodium ethylenediaminetetraacetate and detergent (CA-EDTA) was developed as a mild chemical decontaminant for the removal of loosely held radioactive products from components such as mechanisms. It was originally considered relatively innocuous to reusable component parts. However, decontamination of canned rotor pumps with the CA-EDTA solution resulted in attack of the Malcomized (nitrided) 17-4 PH thrust runners and journals. Preliminary tests of nitrided 17-4 PH specimens also indicated susceptibility to corrosion in the CA-EDTA process. Hence, prior unrestricted use of CA-EDTA in component decontamination was questioned, and a test program to study the corrosiveness of the CA-EDTA process on structural materials was undertaken. A preliminary investigation was made of the effect of several permissible variations of this solution on Malcomized 17-4 PH stainless steel specimens. Although the specimens were attacked under every set of conditions, the most corrosive combination was: CA-EDTA solution at 200°F, pH 3, 4-hour duration with 1 and 10-kilowatt ultrasonics, 2 mils case depth (1/3 of original nitrided case), wire-brushed. A pre-passivation treatment with 0.2N $Na_2Cr_2O_7$ solution appeared to have no effect; temperatures, duration, and brushing had the greatest effects. Weight losses in these tests were as high as 1150 mg/dm^2, but generally ranged from 200 to 700 mg/dm^2, with an average of approximately 400-500 mg/dm^2. These results were used to establish the worst set of test conditions for the CA-EDTA study program. (auth)

3471 (WAPD-BT-25(p.87-94)) THE REACTIVITY (k_{∞}) OF THE TERNARY SYSTEM ZIRCONIUM–WATER–URANIUM-235. G. P. Rutledge and F. A. Dobbe (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

To aid the criticality engineer in determining the k_{eff} of various mixtures of Zr, water, and U^{235}, isoreactivity lines as a function of composition and buckling were determined using a two-group model. Constants for the slow group were obtained with the KATE-1 code. The one-group fast constants were obtained using the MUFT-5 code which utilizes a 54 energy-group spectrum. The two-group analytical model used was checked successfully against many experimental critical assemblies. (auth)

3472 (WAPD-BT-25(p.95-102)) A COMPARISON OF METHODS OF DETERMINING THE COUNT RATE OF RADIOACTIVE MATERIAL. W. L. Davis (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Three methods of estimating the parameter λ of a Poisson distribution are compared for two statistical properties: unbiasedness and relative magnitudes of the variances of the estimators. The subject has particular pertinence when λ is the count rate in low count disintegrations of radioactive material. The fixed time method is the most desirable from the statistical point of view. (auth)

28423 (WAPD-T-1456) APPLICATION OF DIFFUSION CALCULATIONS TO N-16 SPECIFIC ACTIVITY. K. Shure and N. R. Williamsen (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1962. Contract AT(11-1)-Gen-14. 13p.

An efficient technique embodying one-energy-group diffusion calculations is described for use in determining high-energy neutron flux distributions in reactor systems for application to N^{16} specific activity. The technique is adaptable to an arbitrary spatial fission variation in one or more dimensions. (J.R.D.)

28424 (WAPD-T-1474) COMPUTATION SCHEMES FOR REACTOR THERMAL TRANSIENTS. Garrett Birkhoff and Thomas F. Kimes (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1962. Contract AT(11-1)-Gen-14. 23p.

A discussion is presented concerning the computation schemes presented as mathematical models. The discussion is divided into sections on conventional reactor dynamics, boiling water reactors, single coolant channel models, and simplified flow models. Limitations of the models are examined. An analysis of codes includes the CHIC-1, CHIC-2, CHIC-3 and MIM for thermodynamic calculations. (J.R.D.)

28425 (AEC-tr-5162) DEVICE FOR CLOSING REACTOR CHANNELS. Léon Le Flem, Daniel Voelthel, and Jacques Jouin. Translation of French Patent Application. Jan. 18, 1962. 8p.

An invention is described which pertains to a closing device that allows reactors to be charged and discharged during operation. The arrangement permits a regular distribution of reactor channels while affording effective protection against radiation. (J.R.D.)

28426 (CEA-tr-A-1062) CALCUL DE LA CIRCULATION DANS UN REACTEUR A EAU BOUILLANTE. [PARTE] III. (Calculations of Circulation in Boiling Water Reactors. Part III). W. Balz and R. Schwarzwaelder. Translated into French by Z. Horusitzky from Atomkernenergie, 5: 86-91(Mar. 1960). 20p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 14578.

28427 (CEA-tr-R-1596) DE L'INFLUENCE DE L'ANISOTROPIE DE DIFFUSION SUR LE REGIME CRITIQUE D'UNE SPHERE MULTIPLICATRICE. (On Influence of Anisotropic Scattering on Criticality of a Multiplying Sphere). Yu. (Y.) S. Sigov. Translated into French from Vestnik Moskov. Univ., Ser. III. Fiz. Astron., 15: No. 4, 79-85(June-Aug. 1960). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 17763.

28428 (CEA-tr-X-372) TRAITEMENT DES RÉSIDUS RADIOACTIFS PROVENANT D'UNE INSTALLATION DE PROPULSION NUCLÉAIRE NAVALE. (Treatment of Radioactive Wastes from a Naval Nuclear Propulsion Plant). Luigi Pizzi. Translated into French by L. Roulet from p. 431-48 of "VI Rassegna Internazionale Elettronica e Nucleare. Atti Del Congresso Scientifico, Giugno 1959. Sezione Nucleare. Volume II." 23p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 14, abstract no. 10253.

28429 (EURAEC-286) VIBRATIONS AND LOAD LOSSES IN TUBULAR CLUSTERS. Special Report No. 2, March to November 1961. (Société Grenobloise d'Etude et d'Applications Hydrauliques, Grenoble, France). Jan. 1962. Work performed under United States–Euratom Joint Research and Development Program. 115p. A translation of R-8107.

Activities are reported in a program to study the vibrations of fuel tube nests immersed in a fluid flow. One type of nest considered corresponds to heat exchangers in which the flow is perpendicular to the elements of the nest, while the other type corresponds to reactors in which the direction of flow is parallel to the elements. Results of vibration tests confirmed the formulas which were derived. Various factors which modify the theoretical frequency are discussed. (J.R.D.)

28430 (FTD-TT-62-439) ORGANIC SUBSTANCES AS REACTOR MODERATORS. I. Kiss, I. Kosa-Somogyi, and Inna Szabo. Translated from Kernenergie, 4: 905-12(Dec. 1961). 15p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 15802.

28431 CHARACTERISTICS OF AUTOMATIC REACTOR STARTUP. I. Udrya, L. Mentesku, and K. Kharaga. Acad. rép. populaire Roumaine, Rev. phys., 6: 289-97 (1961). (In Rumanian)

The temperature coefficient of reactivity is considered in selecting conditions for doubling reactor power. Considering the rod position as zero at shutdown, the reactivity 45 min after shutdown is positive and is within the range 0 to 0.184×10^{-2}. The negative slope of the reactivity does not stimulate the reactivity by shifting absorbing rods. During the first 20 min after shutdown the sensitivity of measuring instruments is higher than after prolonged shutdown and requires compensated ionization chambers. (R.V.J.)

28432 WATER COOLANT ACTIVATION IN THE PRIMARY CIRCUIT OF VVR-S REACTOR IN BUCHAREST. A. Filip, I. Grancha, and E. Ionesku. Acad. rép. populaire Roumaine, Rev. phys., 6: 299-304(1961). (In Rumanian)

Coolant activity in the primary circuit was analyzed by separating the radioactive element and determining β particle energies (by absorption-method, γ-ray energies (by scintillation spectrometry), and half lives. Typical absorption curves and γ spectra are given. The radioactivity of primary coolant is due to aluminum activation and stainless steel corrosion. (R.V.J.)

28433 BEHAVIOR OF PRIMARY CIRCUIT COOLANT IN BUCHAREST VVR-S REACTOR. D. Stoyan and I. Geletsanu. Acad. rép. populaire Roumaine, Rev. phys., 6: 325-8(1961). (In Rumanian)

The introduction of filters improved the operation of the reactor by reducing sedimentation and organic material content. The pH was retained at 5.5 to 5.6. Filters also reduce the corrosion of pumps and valves. (R.V.J.)

28434 NEUTRON AND γ FLUX DISTRIBUTION IN BUCHAREST VVR-S REACTOR. T. Roshesku and M. Sabeu. Acad. rép. populaire Roumaine, Rev. phys., 6: 329-34(1961). (In Rumanian)

Neutron and γ spatial and energy distributions were studied from operation and research points of view by means of activation, chemical dosimetry, G-M counters, scintillators, and ionization chambers. The flux magnitudes were taken at the nominal operating power of 2000 kw. The order of error is 10 to 20%. (R.V.J.)

28435 THE FAST REACTOR. W. W. Nijs. Atoomenergie, 4: 111-23(June 1962). (In Dutch)

A general survey is given on the advantages and principles of the fast reactor type. The present activities in Europe on the fast reactor are illustrated. (tr-auth)

28436 INVESTIGATION ON THE FUNCTIONING UNDER HYPERCRITICAL CONDITIONS OF PRESSURE AND TEMPERATURE OF A NATURAL CIRCULATION WATER CIRCUIT FOR NUCLEAR REACTORS. Carlo A. Arneodo. Atti accad. sci. Torino. I. Classe sci. fis., mat. e nat., 95: 809-21(1960-61). (In Spanish)

Experiments which show the possibility of stable operation with natural circulation during hypercritical regimes of pressure and temperature by avoiding the formation of destructive thermal fluxes are briefly described. (J.S.R.)

28437 RADIATION DOSIMETRY OF THE RA REACTOR AT VINCHA. MEASUREMENTS BY CHEMICAL DOSIMETERS. O. Gal, S. Pribičević, S. Konstantinović, and I. Draganić. Bull. Inst. Nuclear Sci. "Boris Kidrick" (Belgrade), 13: No. 1, 53-75(Apr. 1962). (In English)

Attempts were made to analyze the problems and the possibilities of measuring reactor radiation by chemical dosimeters. Techniques used for measurements in the RA Reactor at Vincha are described. The distribution of the absorbed doses in the vertical experimental holes was determined at different distances from the center of the reactor core both before raising of the reactor power and during a run at 500 kw. Some preliminary measurements were also made during a reactor run at 1 kw. An oxalic acid dosimeter was used for measurements at 500 kw, and a ferrous sulfate dosimeter was used for the others. (auth)

28438 REACTIVITY EFFECTS OF MODERATOR EXPULSION IN AN ENRICHED, LIGHT WATER REACTOR. Jerome Lee Shapiro (Univ. of Michigan, Ann Arbor). Dissertation Abstr., 22: 1120-1(Oct. 1961).

An experimental and analytical investigation of the effect of removal of part of the water moderator on the reactivity of a small pool-type reactor is made. The experimental technique consists of bubbling air through one element of the core at a time. The air volume (which is considered to be a void) is determined by calibrating measurements made in an out-of-core gamma ray densitometer. Density perturbations made in individual (3" × 3") core elements produce void coefficients ($\equiv \nu\Delta k/k\Delta w$) varying from −0.316 at the center to −0.110 at the outer corner of a roughly square core. The average void coefficient produced by volumetrically averaging all the local coefficients is −0.190. Linearity of the reactivity effect with void concentration is observed up to the maximum void fraction introduced of 11 per cent. This result is compared with a diffusion-theory analysis that includes a comparison of two-group perturbation, using one-dimensional and two-dimensional eigenvalue-variation methods. This comparison shows that for uniformly distributed density changes, perturbation theory is simple and accurate within 5 per cent. It is also apparent that variation of the geometry (e.g., cylindricizing a parallelepiped) has very little effect on either uniformly distributed or localized reactivity effects. Effects of neutron streaming, neutron temperature changes, and changes in flux depression are shown to be negligible in the average water density range ($\rho > 0.75$ gm/cc) examined. The most important feature not adequately accounted for by applying density-changed cross sections to one- or two-dimensional codes is the variation of transverse bucklings. This feature is examined with the aid of the Buckling Iteration

subroutine of the MAGNUM code. The combination of buckling iteration with any of the two-group techniques considered adequately solves the distributed void coefficient problem. However, for localized voids this technique is not accurate since it assumes no radial variation of axial buckling (separability). The interior void coefficient is overestimated while the outer void coefficient is underestimated (both by about 15 to 30 per cent). On the basis of this evidence suggestions are made for modification of the buckling iteration procedure to allow radial variations of axial bucklings.

3439 LOW POWER CALIBRATION BY THE SOURCE INTRODUCTION METHOD. Setsuo Kobayashi and Iwao Kobayashi. Nippon Genshiryoku Gakkaishi, 4: 355-61 (1962). (In Japanese)

The so-called "source-introduction method" was applied to the power calibration of the Semihomogeneous Critical Experiment "SHE" in JAERI and compared with the neutron flux integral method. The "source-introduction method" yielded easy determinations of the power level directly. The accuracy of this method was comparable to that of the neutron flux integral method. (auth)

3440 STUDY ON AXIAL SPATIAL KINETICS IN THE CASE OF CALDER HALL TYPE REACTOR. Atsushi Tohoda. Nippon Genshiryoku Gakkaishi, 4: 377-85(1962). (In Japanese)

There is some difficulty in analyzing the axial spatial kinetics of a reactor by means of modal transfer function technique because of the existence of the temperature integral effect resulting from coolant flow. The modal transfer function technique has such merit, however, that it gives qualitative views in the kinetic character of the reactor. The modal transfer function technique is developed to analyze the axial spatial kinetics of the Calder Hall type reactor. Interesting results from the viewpoint of control theory are obtained. It is found that: modal interaction acts as negative feedback, and therefore that the interaction can be neglected in the case of the stability criterion: and that the control system can act as positive feedback at some insertion depth of the control rod, and there is some possibility that negative feedback might not be attainable at any insertion depth of the control rod, depending upon the heat transfer character and temperature coefficient of the reactor. (auth)

3441 REFLECTOR MODERATED REACTORS. C. B. Mills (Los Alamos Scientific Lab., N. Mex.). Nuclear Sci. and Eng., 13: 301-5(Aug. 1962).

The complete spatial separation of moderator and uranium fuel bearing regions are shown by experiment to result in critical reactors with low critical mass and relatively uniform fissioning density. Studies of several of these experiments to establish the accuracy of a numerical method of calculation (SNG) for this class of problems show good correspondence between theory and experiment. This method is then used for a useful survey of critical mass and U^{235} atomic density as a function of geometry for the best moderators, D_2O and Be. (auth)

3442 TRANSIENT THERMAL BEHAVIOR OF EXPERIMENTAL UO_2 FUEL ELEMENTS IN THE SODIUM REACTOR EXPERIMENT (SRE). J. T. Ream and R. P. Varnes (Atomics International, Canoga Park, Calif.). Nuclear Sci. and Eng., 13: 325-37(Aug. 1962).

It was planned to test full scale UO_2 test elements in the SRE core. Before doing this, an analysis of the transient behavior of the system in part and the whole was carried out. This analysis concerns the problem of determining transient thermal gradients in the Sodium Reactor Experiment core due to the inability of the after-scram braked flow of the sodium to properly cool the UO_2 fuel test elements. The analysis showed that the UO_2 fuel elements could not be irradiated at the desired core position for maximum power density without exceeding the allowable transient thermal gradient limit. It was necessary to shift them to a position of 25% lower power. An experimental scram of the SRE verified these results for the 19-rod cluster type element. It was possible to concentrate the investigation on the region of the core containing the UO_2 test elements using the assumption that the steady-state relationship between core pressure drop and reactor flow was valid during flow coastdown. Distributed spatial parameter effects were approximated by a "lumped"-parameter model and were incorporated in sets of coupled finite difference equations which were then solved by use of a general purpose de analogue computer. The transient flow in the test elements were computed from the SRE quasi-steady-state pressure drop as a function of time. The higher sodium outlet temperature in the UO_2 test element channels results in an elevation head greater than the elevation head in an SRE channel. This nonlinear buoyant force could not be neglected because it significantly increases the transient flow in the UO_2 fuel element and stabilizes the channel outlet temperature. (auth)

28443 THE EFFECT OF MODAL INTERACTION IN THE XENON INSTABILITY PROBLEM. Geza L. Gyorey (Univ. of Michigan, Ann Arbor). Nuclear Sci. and Eng., 13: 338-44(Aug. 1962).

The space and time dependent reactor stability problem of neutron flux shape variations due to Xe^{135} is examined. The effect of modal interaction on stability is investigated for a simple reactor model when the characteristic functions of the wave equation are used in a modal expansion. It is shown that modal interaction may contribute to or detract from stability depending on the circumstances, and that in the case of a very large reactor, stability can be seriously overestimated if modal interaction is neglected. (auth)

28444 COMPARISON OF FLUX RATIO CALCULATIONS IN LATTICES BY INTEGRAL TRANSPORT THEORY. Yuzo Fukai (Nippon Atomic Industry Group Co., Ltd., Tokyo). Nuclear Sci. and Eng., 13: 345-54(Aug. 1962).

In calculating a closely packed lattice, it is well known that one-velocity integral transport theory is the most useful method. Results are briefly presented for calculation of the ratio of moderator to fuel flux in a lattice, $\bar{\phi}_1/\bar{\phi}_0$, by first and second approximations which have been developed by Corngold. In order to compare these approximations with various other calculating methods, some approximate formulations of a penetrability factor are discussed. After comparing the numerical results from the first and second approximations with the ones of Wachspress, Amouyal, Bengston, and the blackness method, the second approximation is considered to be the best. Consequently the values of the flux ratio in a lattice of fuel cylinders are calculated by using a unit cell method, and the second approximation in the case of a slab lattice which has a mean chord length equivalent to that of the actual lattice, and the results are compared with experiment. (auth)

28445 MEASUREMENT OF F^{19} ACTIVATION IN THE CORE OF A WATER-COOLED REACTOR. L. Balcarczyk, K. H. Kim, and E. Lanzel (Österr. Studiengesellschaft fur Atomenergie G.m.b.H., Vienna). Nukleonik, 4: 105-8(Apr. 1962). (In German)

The fluorine activity in the ASTRA Reactor, generated at

a given fast neutron flux by the nuclear reaction $O^{18}(p,n)F^{18}$ was determined. The fluoride activity was measured both before chemical removal of all perturbing activities and after chemical separation. In contrast to the F^{18} initial activity determined by chemical separation, the contribution of Na^{24} to the 0.51-Mev line must be corrected in the purely physical measurement. The F^{18} activity measured without chemical separation with the deduction of the correction factor and the F^{18} activity before chemical separation show variations up ±5%. The measurement of the absolute neutron flux and the flux distribution was carried out by the $S^{32}(n,p)P^{32}$ nuclear reaction, the mean saturation activity per ml of solution at a point distributed over the complete fuel zone of the standard elements was determined, and the activation of F^{18} was determined in dependence on the fast neutron flux. The saturation activity per ml of solution, at a fast neutron flux of 10^{11} n/cm² sec, is 0.29×10^{-9} C. The limits of error in the determination of the F^{18} initial activity is ±10%. (tr-auth)

28446 THE APPROXIMATE SOLUTION OF THE DIFFUSION EQUATION BY A SEPARATION EXPRESSION IN THE UNIVERSALLY REFLECTING CYLINDRICAL REACTOR. Hans-Juergen Siegert (Technische Hochschule, Stuttgart). Nukleonik, 4: 149-51(Apr. 1962). (In German)

The critical dimensions of the fission zone and the neutron distribution of a universally reflecting reactor were calculated according to the concept of reflector economy. The flux was represented by a separation expression. The results were compared with the exact values calculated with a difference program. It was shown that the critical dimensions and, in a large part of the reactor, the flux pattern also agrees well with the exact values. (tr-auth)

28447 SIGNAL FLOW AND ANALOG DESCRIPTION OF NEUTRON ECONOMY IN BURNUP OF REACTOR FUEL ELEMENTS. Walter Haelg (Eidgenossische Technische Hochscule, Zurich and Eidgenössische Institut für Reaktorforschung, Würenlingen, Ger.). Z. angew. Math. u. Phys., 11: 433-44(1960). (In German)

The Laplace transforms of the linearized equations for long-term irradiation of reactor fuel are arranged as a signal flow diagram which can either be used to solve the system or to make clear the correlation between various terms. Solutions for the uranium-plutonium cycle obtained with an analog computer are compared with results from digital evaluations. A general definition for the irradiation-dependent fuel regeneration factor is introduced. (auth)

28448 REACTOR FUEL PROCESSING. Volume 5, No. 3. Stephen Lawroski, ed. (Argonne National Lab., Ill.). July 1962. 74p. (GPO) $0.55 (domestic), $0.70 (foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC).

Developments in reactor fuel processing are reviewed. Topics covered include: commercial aspects of fuel processing; research and development on aqueous processing; research and development on non-aqueous processing; waste disposal; and production of uranium, thorium, plutonium, and their compounds. (M.C.G.)

28449 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. André Huet. British Patent 900,015. July 4, 1962.

A boiling reactor is designed with liquid-vapor separators disposed between fuel rods which are of quadrilateral form with inwardly curved sides to fit the separators. The reactor may be used with an arrangement for varying the distances between the fuel rods. One advantage of the reactor is that it can operate at an inclined angle, e.g., on ships. (D.L.C.)

28450 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). British Patent 900,076. July 4, 1962.

An improved reactor core arrangement is described which gives uniform flux and less risk of local overheating. The fuel channels are arranged into a first square lattice, while the control rod channels are placed in a second square lattice inclined at 45° to the first lattice and with lines passing through points of intersection of the first lattice. The spacing is such that two fuel channels are placed between two adjacent control rod channels. (D.L.C.)

28451 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. James Carrie Ould (to United Kingdom Atomic Energy Authority). British Patent 900,078. July 4, 1962.

A fuel element for gas-cooled reactors is designed with means for restraining the element against vibration induced by coolant flow. The means comprises a plurality of bimetallic strip members attached to the element in such a way that an increase in ambient temperature causes the members to expand and contact the channel wall. (D.L.C.)

28452 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR CORE SUPPORT STRUCTURES. Alan Henry Butler (to General Electric Co. Ltd.). British Patent 900,235. July 4, 1962.

A core support structure for gas-cooled, graphite-moderated reactors is designed so that the load is distributed uniformly around the peripheral support. The structure is of the type comprising a support platform, a grillage beneath the platform, and a peripheral support on which the grillage is mounted. The grillage comprises a symmetrical arrangement of beams connected together at a central point and extending radially therefrom, with their outer ends supported on the peripheral support. (D.L.C.)

28453 IMPROVEMENTS RELATING TO SELECTOR VALVES FOR NUCLEAR REACTORS. John Raymond Dean and John Richard Brown (to Reyrolle and Co. Ltd.). British Patent 900,308. July 4, 1962.

A selector valve is designed for selectively coupling the fuel channels of a gas-cooled reactor to a sampling device for testing channel coolant streams for radioactivity. The valve comprises a valve body with rows of spaced inlet and outlet ports, all leading into a common outlet passage, a selector member, means for moving the selector member and for putting two ports into communication with each other via a bridging conduit, and means for closing the other ports. (D.L.C.)

28454 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS AND TO STRAIN INDICATORS THEREFOR. David William Williams and William Paul White (to United Kingdom Atomic Energy Authority). British Patent 900,347. July 4, 1962.

A sheathed reactor fuel element is designed with a strain indicator for detecting localized swelling of the sheath such as that due to fuel oxidation by coolant ingress. The strain indicator comprises closed alumina tubes enclosing U wire and arranged around the fuel element in such a way that swelling of the sheath ruptures the tubes, releasing fission products into the coolant stream which in turn can be detected easily. (D.L.C.)

28455 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. David William Williams, John George Edwards, and Arthur William Shilling (to United Kingdom Atomic Energy Authority). British Patent 900,348. July 4, 1962.

A sheathed reactor fuel element is designed with means

for indicating fuel oxidation by coolant ingressing through the sheath. The means comprises a substance inside the sheath which, at a temperature above the normal operating temperature for the fuel element, expands more rapidly than the fuel member and sheath so as to distort the sheath. The sheath distortion may be detected by a strain indicator described in British Patent 900,347. The substance may be Al, Mg, or uranium iodide which undergoes a physical or chemical change at a suitable temperature. (D.L.C.)

28456 IMPROVEMENTS IN AND RELATING TO NUCLEAR REACTORS. Roderick Taylor (to Head, Wrightson and Co. Ltd.) British Patent 900,579. July 11, 1962.

A core construction for graphite-moderated, gas-cooled reactors is designed which eliminates transverse displacements between the bottom layer of bricks and the supporting base plate and the need for elastic restraints. The graphite bricks are formed with their end faces inclined to the horizontal and arranged so that adjacent pairs form a wedge shape at their upper ends and a V-shaped recess at their lower ends or vice versa. Pins are provided between the bricks to form channels and to permit pivotal movements between the bricks. The core is supported on tiles with V-shaped recesses. (D.L.C.)

28457 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. Anthony James Taylor (to Babcock and Wilcox Ltd.). British Patent 901,171. July 18, 1962.

A fuel element was developed for use in a vertical fuel channel of a nuclear reactor. It is provided at one end with positioning means which includes several lateral support members angularly distributed around the axis of the fuel element, pivotally mounted and rotatable to effect radial projection and retraction of the members. The other end of the fuel element is provided with actuating means adapted to co-operate with the positioning means of a similar fuel element when the elements rest one upon the other. The positioning means are operable from a condition in which they exert a wedging action to a condition in which they permit movement of the fuel elements longitudinally in the fuel channel. (M.C.G.)

28458 PROCESS FOR EFFECTING A SELF-SUSTAINING NUCLEAR FISSION REACTION. (to Stichting Reactor Centrum Nederland). British Patent 901,330. July 18, 1962.

The problem of removing fission products from reactors fueled with a circulating suspension of fissile material was studied. It was found that fission products can be removed by including in the suspension of fuel particles a proportion of fissile particles substantially finer than the bulk of the fissile particles constituting the fuel charge. If these fine particles are included, the establishment of the adsorption equilibria of the fission products involves adsorption of the fission products almost exclusively on the very fine particles. The finer fissile particles with adsorbed fission products are separated from the coarser fissile particles by use of hydrocyclones. (M.C.G.)

28459 IMPROVEMENTS IN OR RELATING TO NEUTRON DETECTORS. (to Siemens-Schuckertwerke Aktiengesellschaft). British Patent 901,508. July 18, 1962.

Improvements in probes for detection and measurement of neutron fluxes in reactors are described. The sensitivity for the probe was improved by placing additional fissionable material, for example in the form of a uranium plate, in a region adjacent to the probe, preferably in a reflector zone of the reactor. The distance of the fissionable material from the reactor core and the vessel wall is adjustable. (M.C.G.)

28460 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. John George Morland (to AEI-John Thompson Nuclear Energy Co., Ltd.). British Patent 901,634. July 18, 1962.

Improvements were made in the flow of coolant gas through a graphite-moderated reactor so that it is not possible for some of the gas to pass laterally through the bearings in such a way as to leak vertically upwards between the joints of the stacked graphite blocks and so not pass up the vertical channels in the graphite structure. At the end of each core passage an extension pipe was provided extending downwards through an aperture in the support plate together with support means for the core. A ball race encircled each extension pipe. A flexible hose connected the extension pipe and the lower edge of the support plate to avoid leakage of the gas between them. (M.C.G.)

28461 IMPROVEMENTS RELATING TO EQUIPMENT FOR CONTROLLING THE MOVEMENT OF A CONTROL ROD IN A NUCLEAR REACTOR. John MacKinlay Yellowlees (to AEI-John Thompson Nuclear Energy Co. Ltd.). British Patent 902,310. Aug. 1, 1962.

Equipment was developed for controlling the movement of a control rod in a nuclear reactor. The equipment consists of an output shaft located outside the pressure vessel, means for rotating this shaft, a drive shaft located inside the pressure vessel and connected to a mechanism for moving the control rod in the core, and a magnetic clutch. Advantages of this type of control rod equipment are listed. (M.C.G.)

28462 SECURING DEVICES FOR FUEL ELEMENTS IN NUCLEAR REACTORS. (to Sulzer Freres, Societe Anonyme). British Patent 902,376. Aug. 1, 1962).

Devices were developed for securing fuel elements in a nuclear reactor in which rod-like fuel elements containing a fissile material are disposed in a moderator and the fuel elements are connected to coolant piping connections in the securing devices. These devices consist of stationary connecting elements equipped with coolant piping connections, a movable securing element which thrusts the fuel element against the connecting element, and a resilient member which is interposed between the other two. (M.C.G.)

28463 NUCLEAR REACTOR CONTROL ELEMENT. (to U. S. Atomic Energy Commission). British Patent 902,786. Aug. 9, 1962.

A boron-containing control element is designed which gives uniform boron burnup on irradiation and thus gives a longer operating lifetime. The boron concentration varies from a maximum at the center to a minimum at the surface and preferably is distributed according to the equation $N = N^0(1 + \sigma I)/1 - (i - 1)(C/I_0)$, where N = number of B^{10} atoms/cm^2 in the thickness increment No. i of the element, N^0 = number of B^{10} atoms/cm^2 in the outermost increment No. 1, C/I_0 = probability of neutron capture in increment No. 1, I = total neutron flux incident on increment No. i, and σ = absorption cross section of B^{10}. The element may be fabricated from a series of thin plates containing different B^{10} concentrations. (D.L.C.)

28464 IMPROVED CHIMNEY FOR BOILING WATER REACTOR. (to U. S. Atomic Energy Commission). British Patent 902,797. Aug. 9, 1962.

A natural-circulation boiling reactor is designed for increased circulation driving head without increased two-phase fluid flow resistance. In place of individual chimneys for each coolant channel, the reactor has a large riser which results in lower fluid flow resistance, maximum steam dissociation from the saturated water entering the

downcomer, and control of flow rates through different portions of the core. An embodiment of the reactor is described for the modified EBWR, whose heat output was raised from 20 to 100 Mw with this invention, and plant parameters are tabulated for the modified EBWR. (D.L.C.)

28465 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Terence Graham Bryant and Bryan John Dobbs (to AEI-John Thompson Nuclear Energy Co. Ltd.). British Patent 902,833. Aug. 9, 1962.

A boiling water reactor is designed with high coolant circulation for increased efficiency. The fuel rod assemblage is arranged to provide upward coolant flow passages between the fuel rods and one or more downflow passages outside the assemblage for inducing circulating convection currents. Chimney passages are provided on the top of the fuel assemblage to extend the upflow passages and increase the circulation, the passages being higher over the central area where the fuel rods are hottest than over the outer area. In the embodiment described, the chimney passages form cruciform passages for accommodating the control rods. (D.L.C.)

28466 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. Norman Rostron (to United Kingdom Atomic Energy Authority). British Patent 902,889. Aug. 9, 1962.

A sheathed reactor fuel element with the fissile rod spaced from the end caps by heat-insulating spacers is designed so that the spacers are restrained from lateral movement against the sheath. The fissile rod has a series of circumferential grooves along its length, and the sheath is pressed into these grooves to limit creep in the sheath under thermal cycling. The end caps have grooves for accommodating thin rings of natural U which are to release fission products as warning in event of failure of the edge welds. The end caps also have recesses for locating the spacers and preventing them from stressing the sheath. (D.L.C.)

28467 A GLASS PARTICLE CONTAINING NUCLEAR MATERIAL. (to Compagnie de Saint-Gobain). British Patent 903,080. Aug. 9, 1962.

A process is given for producing spherical glass particles containing fissionable or fertile material. A glass of the composition SiO_2, 35 to 45%, UO_2 20 to 45%, Na_2O + K_2O 15 to 25%, and Na_2O 0 to 8% is made and broken into fragments, and the fragments are graded and converted into spheroids by heating in a gas. The glass particles may with advantage be used as a suspension in a liquid phase in a homogeneous reactor, as disintegration from abrasion is negligible. (D.L.C.)

28468 NUCLEAR REACTOR FUEL ASSEMBLY. (to U. S. Atomic Energy Commission). British Patent 903,227. Aug. 15, 1962.

A direct-cycle boiling reactor and a fuel assembly therefor are designed for producing superheated steam without routing the saturated steam outside the reactor. The fuel assembly, designed specifically for the Experimental Boiling Water Reactor, is of the two-pass type and has a subassembly for downward longitudinal expansion. (D.L.C.)

28469 IMPROVEMENTS IN OR RELATING TO RESTRAINT MEANS AND TO SHUT-DOWN APPARATUS FOR NUCLEAR REACTORS EMPLOYING SUCH MEANS. Ronald Hugh Campbell (to United Kingdom Atomic Energy Authority). British Patent 903,288. Aug. 15, 1962.

A shut-down device for reactors is described which comprises a plurality of neutron-absorbing, magnetic balls held in a tube above the reactor by magnetic forces. The balls may be released into the reactor by demagnetizing the magnetic means, and the magnetic means may be made out of a material whose Curie point is exceeded when the maximum safe operating temperature is exceeded. (D.L.C.)

28470 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR CONTROL APPARATUS. Jack Jones (to United Kingdom Atomic Energy Authority). British Patent 903,289. Aug. 15, 1962.

A reactor control apparatus is designed which avoids the use of cable. The apparatus comprises a nut member restrained against rotary movement, a neutron-absorbing rod, electromagnetic means for suspending the rod from the nut member, and a screw member engaged with the nut member so that rotation of the screw member results in axial movement of the nut member and hence the rod. For emergency shutdown, the electromagnetic means is de-energized to uncouple the nut from the rod and thus allow the rod to fall into the core. (D.L.C.)

28471 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Aktiengesellschaft "Weser"). British Patent 903,303. Aug. 15, 1962.

A gas-cooled reactor is designed for removal of fission products from the coolant. In the reactor, part of the coolant is diverted from the cooling ducts into the fuel channels to sweep out the fission products, and the contaminated gas is fed to a purifier and thence back to the coolant circuit. A ball valve may be provided in each fuel channel for adjusting the fraction of the coolant diverted into the channels. (D.L.C.)

28472 IMPROVEMENTS IN OR RELATING TO PRESSURE VESSELS SUCH AS PRESSURE VESSELS SUITABLE FOR NUCLEAR REACTORS. Peter Neil Munn and Raymond Hindley (to United Kingdom Atomic Energy Authority). British Patent 903,480. Aug. 15, 1962.

A reactor pressure vessel with a diagrid support is designed so that complex stresses due to the support are reduced. The diagrid structure is mounted across the lower end of a first skirt inside the pressure vessel, the first skirt is attached at its upper end to a second skirt spaced from the first skirt, the second skirt is secured at its bottom to the pressure vessel, and the pressure vessel is mounted on an external bottom support skirt which forms a continuation of the second skirt throughout the pressure vessel wall. Thus, means is provided for relative movement between the diagrid and the pressure vessel. (D.L.C.)

28473 IMPROVEMENTS IN OR RELATING TO CORE ELEMENTS FOR NUCLEAR REACTORS. Frank Sterry and George Edward Lockett (to United Kingdom Atomic Energy Authority). British Patent 903,489. Aug. 15, 1962.

A reactor fuel element of the kind described in British Patent 850,015, wherein sleeves containing fissile material are located between a graphite tubular container and a central graphite rod, is designed with means for reducing coolant contamination due to back-diffusion of fission products into the coolant circuit. The graphite container is made from low-permeability graphite, and its top is covered by a porous graphite plug so that some coolant diffuses into the element to dilute the fission products. (D.L.C.)

28474 NUCLEAR REACTOR FUEL ELEMENT AND METHOD FOR MAKING SAME. (to U. S. Atomic Energy Commission). British Patent 903,580. Aug. 15, 1962.

A method is outlined for fabricating a clad fuel plate without undue loss of cladding material and with a reliable metallurgical bond between the fuel and the cladding. The cladding frame comprises a pair of end members provided on their opposing edges with V-shaped grooves, and the

fuel member similarly is provided with beveled end portions which are inserted into the V grooves. The assembly is then heated in a special jacket and rolled to the final shape to obtain bonding between the fuel and the cladding. The angle of the beveled end portions is selected to prevent undue bulging or deformation of the areas adjacent the grooves during the rolling process. The finished fuel plate can be used in the seed portion of the Shippingport Pressurized Water Reactor. (D.L.C.)

28475 PNEUMATIC TURBINE DRIVEN TOOL SUPPORT. (to Société Indatom and Compagnie des Ateliers et Forges de la Loire). French Patent 1,230,021. Sept. 13, 1960.

For cleaning, turning, or reboring the channels of a gas cooled reactor, a pneumatic turbine-driven tool support is described that is adapted to be moved inside the channels, and that comprises a cylindrical casing sliding in the channel and having open extremities allowing gas to flow through it. The rotor of a pneumatic turbine is mounted within this cylindrical casing with the same axis as the latter, the outer ends of the turbine blades being connected to a ring-shaped piece on which the tool (e.g., a cutting tool) is mounted. The casing has an annular opening or interruption in which the ring-shaped piece is situated; which is provided with openings distributed on its circumference. Chips detached from the channel-wall are blown through these openings into the casing and well by the gas circulating in the annular interspace formed by the outer wall of the casing and the channel wall in a region upstream from the turbine rotor. Downstream from the rotor a sack is provided for retaining the chips. The entrance into the sack is provided with shutters, which open automatically under the thrust of the gas flow and close if this thrust ceases or falls under a predetermined value. (NPO)

28476 COMPOSITE FUEL ELEMENT. (to U. S. Atomic Energy Commission). French Patent 1,230,671. Sept. 19, 1960.

A nuclear fuel element is described that comprises a plane plate having a plurality of perforations. At both faces of this plate, cover sheets are fixed so that the spaces occupied by the perforations form cells in which the fissile material is placed. Preferably the plate has an elongated rectangular shape and the said cells are placed at least at a given distance from the edges. The cover sheets are preferably made from the same material as the plate, and are so fixed onto the plate that each cell forms a gas tight space. The plate and the sheets preferably are made from aluminum, stainless steel, zirconium, or zirconium alloys. The fuel elements are positioned in the reactor so that two adjacent elements form a channel between them. (NPO)

28477 STEP BY STEP DRIVE MECHANISM AND CONTROL ROD DRIVE MECHANISM FOR NUCLEAR REACTORS UTILISING THIS DRIVE MECHANISM. (to Société Indatom). French Patent 1,233,088. Oct. 12, 1960.

The control rod of a nuclear reactor is connected with a drive bar having a preferably prismatic cross section, each side face of which is provided with a toothed rack, the toothed faces being perpendicular to the direction of movement of the bar. This movement is effected by the action of hydraulic jacks, each of which is movable in the same plane and perpendicular to the direction of movement of the bar. Each jack has a movable portion provided at one of its extremities with teeth having essentially the same shape as the teeth of the racks, so that the teeth of the jack may engage with the teeth of a rack corresponding to that jack, in order to move the bar in a forward or reverse direction. The forward movement of the jack to engage it with the rack is controlled by periodical connection of the jack with a source of pressurized fluid, while its withdrawal movement is effected by spring action. The cycles of movement of the different jacks are phase shifted, so that corresponding to given phase shifts the bar moves either forward or backward. (NPO)

28478 SAFETY RELEASE MECHANISM. (to The Nuclear Power Plant Co., Ltd.). French Patent 1,234,552. Oct. 18, 1960.

A safety mechanism is described that releases a member from a parent member, in response to changes in pressure in a fluid in which the releasable member is immersed. This mechanism comprises a push rod attached to the releasable member that can trip a latch mechanism joining the releasable member to the parent member, while a pressure-sensitive device is located in the releasable member and forms an enclosed space therein. The pressure-sensitive device is responsive to pressure changes between the enclosed space and the fluid surrounding the member, and exerts a force on the push rod sufficient to trip the latch mechanism when a pre-determined pressure change occurs. Preferably the releasable member incorporates, in addition, means sensitive to temperature changes, so that changes in temperature between fluid surrounding this means and the enclosed space produce differential expansion between this means and the lower part of the releasable member, causing movement of the push rod to trip the latch mechanism. In a suitable embodiment the releasable member supports the safety rod of a reactor so that the tripping of the latch mechanism causes the shut-down of the reactor. (NPO)

28479 MOUNTING DEVICE FOR THE FUEL ELEMENT PLATES OF A NUCLEAR REACTOR. (to Sylvania Corning Nuclear Corporation). French Patent 1,242,422. Aug. 22, 1960.

Reactor fuel elements that consist of a plurality of flat, elongated, generally rectangular fuel plates are provided with supporting members having also a plate shape for holding these fuel plates in a spaced overlying relationship relative to one another. The method of joining these fuel plates with the supporting member consists in longitudinally splitting an edge of each of the plates; stacking the plates in spaced, overlying relationship relative to one another by placing removable blocks between adjacent plates; clamping the stock of plates and blocks together; forming on the supporting members a plurality of tapered channels, each having an outwardly disposed wedge surface on its innermost face; and forcing the split edges of the stacked plates into the channels and against the wedges, thereby spreading the split edges around the wedges and into conforming relationship with the sides of the tapered channels. (NPO)

28480 GRIP WITH ELECTRIC CONTROL. (to Commissariat à l'Énergie Atomique). French Patent 1,244,439. Sept. 19, 1960.

A grip for the remote handling of elements inside a channel of a nuclear reactor is described that comprises, positioned successively inside an elongated cylindrical casing: an electric motor; a reduction gear; a threaded driving shaft at the exit of that gear; a nut screwed on that shaft, which can slide axially, although its rotation is prevented; and a pushrod that controls the opening and closing of a number of jaws pivotally mounted in the casing. The push-rod is provided with two appropriate profiled shoulders, which cooperate with profiled edges of each jaw. Two circuit-breakers are actuated by the push-rod in the opened

and closed position of the grip to control the feeding circuit of the electric motor. (NPO)

28481 IMPROVEMENTS RELATING TO HIGH NEUTRON ABSORBING PLATES, AND NUCLEAR REACTOR CONTROL RODS COMPRISING SUCH PLATES. (to The Babcock & Wilcox Co.). French Patent 1,244,777. Sept. 19, 1960.

A highly neutron-absorbing control rod for a nuclear reactor comprises a rectangular plate of metal provided with a plurality of holes extending throughout its length, the holes being filled with the highly neutron-absorbing material. The holes are arranged in a staggered pattern. Each hole is in cross-section a quite elongated ellipse. For making such a plate, a plurality of the holes are drilled through an elongated plate, the major axis of the holes being parallel to the main surfaces of the plate. The holes are then filled with highly neutron-absorbing material and the open ends of the holes are closed with malleable metal plugs. Afterwards the plate is brought to a reduced thickness by roll forming in order to produce a flattening of the round drilled holes to the form of elongated ellipses. (NPO)

28482 NUCLEAR REACTOR CONTROL. (to United Kingdom Atomic Energy Authority). French Patent 1,244,854. Sept. 19, 1960.

A nuclear reactor comprises fuel element assemblies immersed in a liquid coolant. These assemblies are held in the normal position with respect to each other by forces exerted on them by the coolant flowing through the reactor core. A decrease of these forces caused by a coolant loss releases the assemblies, so that they get out of place such as to produce a dispersion of the core and make it subcritical. For producing these forces, blades are mounted on both the reactor structure and the fuel element assemblies, so that these blades cause changes in the flow direction of the coolant circulating through the core. Preferably these assemblies are supported such that they fall out of place under the action of gravity when they are released. (NPO)

28483 NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,244,855. Sept. 19, 1960.

A reactor is described that comprises a core wherein the fuel elements are assembled in groups. Elements of a given group are positioned vertically, in common support means, so that the elements (which have an elongated shape) form in the support a row, the whole having the general shape of a plate. The core is composed of a series of these fuel element plates parallel to one another, immersed in liquid coolant. Means are provided for displacing the support plates in a general horizontal direction parallel to the front faces, so that each element of the plate may be brought into alignment with a charging or discharging hole provided for each plate in the container wall. (NPO)

28484 FLUID TIGHT ELECTRO-MAGNET, ESPECIALLY FOR THE CONTROL ROD DRIVE IN SWIMMING POOL REACTORS. (to Commissariat à l'Énergie Atomique). French Patent 1,244,959. Sept. 26, 1960.

In swimming pool reactors it is usual to couple the control rod with its drive means via an electromagnet, so that upon breaking of the feeding current of the electromagnet, the control rod is released and falls down into the reactor core. Generally it is necessary to provide a system for the indication of the state of coupling or decoupling of the rod. Coupling means are described that comprise a fluid-tight vertical cylindrical casing suspended by the drive means, and an electromagnet having a pot-shaped core open at the bottom and movable between an upper and a lower position. If the lower face of the casing touches the lifting head of the rod and if the electromagnet is energized, the core moves downward against the action of a spring, into its lower position, so that the magnetic field lines may be closed via the lifting head so that the rod is coupled. Upon de-energizing of the electromagnet, the spring moves the magnet into its upper position. The movement of the electromagnet controls a micro-switch interconnected in the circuit of the indication system. (NPO)

28485 CONTROL DEVICE FOR A CHARGING CHUTE FOR NUCLEAR REACTORS. (to Société Indatom). French Patent 1,245,733. Oct. 3, 1960.

An articulated charging chute for nuclear reactors, which is placed into a charging hole and serves a group of reactor channels, is provided with pneumatic or hydraulic means for bringing the lower end of the charging chute successively over the exits of each of the channels. The chute is composed of an upper tubular portion rotatably mounted in the charging hole, and a lower tubular portion pivotally mounted at the lower end of the upper portion and linked with a further tubular piece axially sliding on the upper portion, so that this axial displacement determines the lateral position of the lower portion of the chute. This tubular piece is attached to an annular piston sliding on a portion of the charging-hole wall. The required axial displacement is performed by connecting the spaces above and below the piston with fluid-pressure sources. The tube is provided with two pins mounted at its inner and outer wall respectively, which engage in profiled grooves having the general shape of a series of waves of different height, the grooves being provided in pieces fixed to the charging hole, so that by commutating the pressure the lower end of the chute may be brought into each of its working positions. (NPO)

28486 PROCESS AND DEVICE FOR GAS SAMPLING FROM THE CHANNELS OF A GAS COOLED NUCLEAR REACTOR. (to Société Indatom). French Patent 1,245,734. Oct. 3, 1960.

A process for gas sampling from the channels of a gas cooled reactor is provided, in connection with charging and discharging means, of the type of an articulated hollow arm that serves a number of channels. The process consists in placing the extremity of the arm successively over each channel, so that the end of a flexible sampling duct reaching into the extremity of the hollow arm can pick up a portion of the gas emerging from the channel in question. Preferably the flexible sampling line is connected with an annular space formed between the outer tube of the articulated arm and a groove in the inner wall of the charging hole tube in which this arm is mounted. From this annular space the gas samples are led to an appropriate measuring device for checking the reactivity. (NPO)

28487 MACHINE FOR CHARGING AND DISCHARGING THE CHANNELS OF A GAS COOLED NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,247,088. Oct. 17, 1960.

For charging and discharging a nuclear reactor during operation while it is cooled by a pressurized gas, a refueling machine is provided comprising a pressure container adapted to be coupled, in a gas-tight manner, with each of the charging holes of the reactor. This container encloses means for stocking discharged fuel elements or fuel elements to be loaded into the reactor, a rotative magazine for receiving elements, a hoisting device, and a device for gas-tight closure of the container. The container is supported inside its shielding by clamps arranged such that the container may easily be exchanged without removing the

shielding. The gas-tight coupling of the machine with a charging hole is performed by telescopic coupling means forming an extension of the pressure container. (NPO)

28488 NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,247,089. Oct. 17, 1960.

During the refueling operation of a nuclear reactor unusual conditions may arise, e.g., the jamming of a fuel element in the reactor channel, so that special means must be placed on the charging hole for restoring normal conditions. In order to avoid too great a delay in the operation, a refueling machine is provided that comprises, in the proximity of the normal refueling means, special means adapted to restore normal conditions in case it is not possible to do so by the normal refueling means. These special means are similar to the normal refueling means, but are adapted to their special task, and are brought into working position above the charging hole by only a small lateral displacement of the refueling machine. (NPO)

28489 REFUELLING MACHINE FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,247,090. Oct. 17, 1960.

A shielded refueling machine for a nuclear reactor is provided with additional shielding, which is attached to the machine so as to block the free path of radiation that otherwise escape between the machine and the charge face of the reactor. This additional shielding is attached to the machine by means of screw-threaded shafts and can be moved by rotating these shafts collectively. Preferably this additional shielding has parts that can move with respect to the other parts of the additional shielding into contact therewith. The additional shielding parts may comprise interlocking pads loosely secured to the remainder. (NPO)

28490 DRIVE MECHANISM FOR ROTATIVE MEANS. (to United Kingdom Atomic Energy Authority). French Patent 1,247,093. Oct. 17, 1960.

A mechanism is described that insures the selective drive of any of a group of rotative means. This mechanism consists of a support for these rotative means that can be displaced relative to driving means, so that any of the rotative means may be brought into alignment and coupled with the driving means. The rotative means that are not coupled with the driving means are locked, so that they cannot rotate. Preferably the displacement of the support is constituted by a rotation on an axis perpendicular to the axis of the driving shaft to be coupled with the rotative means. The coupling means uses an elliptic cam, which slides in its non-coupled state between two annular surfaces, preventing any rotation of the coupling means and the non-coupled rotative means. This drive mechanism may be used for a refueling machine for nuclear reactors. (NPO)

28491 REFUELLING MACHINE FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,247,094. Oct. 17, 1960.

A shielded refueling machine may be provided with additional shielding that is movable relative to the machine so as to block the free path of radiations, which may otherwise escape between the machine and the charge face of the reactor. Shielding is described for such a refueling machine that comprises a movable portion jointed to the remainder of the shielding, so as to form a door through which operators may enter the machine in order to carry out given tasks. Means are provided for locking all the operations of the machine when the door is open, and for the locking the door in the open position. The last locking means may be controlled only with the aid of a key that the operator is obliged to take with him when he enters the machine. (NPO)

28492 REFUELLING MACHINE FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,247,095. Jan. 29, 1959.

A refueling machine for nuclear reactors comprises means for measuring the temperature of a fuel element coupled with the hoisting means of the refueling machine. These hoisting means comprise a hoisting chain having links with lateral extensions, which support the cable enclosing the conductors necessary for the temperature measuring device. The chain extensions insure that the cable always remains parallel to the chain and does not disturb the engagement of the chain with pullies determining the path of the chain or driving the chain. (NPO)

28493 REFUELLING MACHINE FOR NUCLEAR REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,247,096. Oct. 17, 1960.

A refuelling machine for a nuclear reactor cooled with a pressurized gas has a normally closed circuit using the same gaseous coolant as that employed in the reactor. This coolant is also circulated under pressure. The coolant circuit of the machine forms a part of the reactor coolant circuit and in so doing preserves the integrity of the reactor coolant circuit; thus a fuel element discharged from the reactor by the refueling machine can be cooled during its passage from the reactor core into the refueling machine and also while it is being temporarily housed in the refueling machine. (NPO)

28494 CONTROL DEVICE FOR A CHARGING CHUTE FOR NUCLEAR REACTORS. (to Société Indatom). French Patent 1,248,539. Nov. 7, 1960.

An articulated charging chute for nuclear reactors, which is placed into a charging hole and serves a group of reactor channels, is provided with means for bringing the lower end of the charging chute over the exit of each channel. The chute is composed of an upper tubular portion rotatably mounted in the charging hole, and a lower tubular portion, pivotally mounted at the lower end of the upper portion and linked with a third tubular piece axially sliding on the upper portion, so that this axial displacement determines the lateral position of the lower portion of the chute. The third tubular piece is provided with an outer thread engaging a screw-nut, so that the rotation of this nut induces the axial displacement of the threaded tubular piece. A system of coaxial tools is provided such that each of these tools may control the movement of a given tubular piece of the described charging chute, via lugs supported by these tools and engaging profiled grooves in the inner walls of the tubular pieces. (NPO)

28495 ASSEMBLY OF SOLID MODERATOR ELEMENTS FOR NUCLEAR REACTORS. (to Commissariat à l'Énergie Atomique). French Patent 1,250,669. Dec. 5, 1960.

An assembly of solid moderator elements for a nuclear reactor is described that comprises a plurality of vertical parallel columns, each constituted by a pile of solid moderator elements having along the column axis a channel in which the fuel elements are positioned and in which circulates a gaseous coolant. The elements of each column are spaced from the elements of the adjacent columns such that there is sufficient clearance between adjacent columns to allow free lateral expansion of the elements. Each of the columns is supported at one of its extremities by a bearing-plate abutting against a support-bar fixed to the wall of the pressure vessel enclosing the reactor. At the other extremity of the column a tubular bearing-piece is provided

that can slide vertically on the outer surface of a fixed collar. A helical spring, abutting with its extremities against a shoulder of the tubular bearing-piece and against a shoulder of the collar, allows the axial expansion of the column, thus ensuring cohesion between its elements. (NPO)

28496 PROCESS OF DIFFERENTIATION OF THE ADAPTATION POSSIBILITIES FOR THE ASSEMBLING OF A DEVICE. (to Commissariat à l'Énergie Atomique). French Patent 1,251,465. Dec. 12, 1960.

A device constituted by an assembly of several groups of elements of different kind is described, which has different adaptation possibilities for these elements, such that each element is provided with a male piece characterizing the kind of element and generally fitting into a corresponding female piece during the positioning of the element. The male piece of an element of a given kind fits in several female pieces, but not in all. This prevents the positioning of a given element at certain places. Preferably there are special elements with male pieces fitting in any of the female pieces of the device, while a special female piece may be provided in which any male peice fits. This process may be used for the assembling of a nuclear reactor core comprising a plurality of elements of different kinds, the female pieces forming part of the support structure of the reactor core. The active portion of the reactor may be divided into three zones, viz. the core zone, a mixed zone, and the reflector zone. In the mixed zone both core and reflector elements may be positioned, while the core pieces do not fit into the female pieces of the reflector zone and vice versa. (NPO)

28497 DEVICE FOR REFUELLING A PRESSURIZED NUCLEAR REACTOR DURING THE OPERATION. (to Commissariat à l'Énergie Atomique). French Patent 1,253,820. Jan. 9. 1961.

A nuclear reactor cooled by a pressurized fluid is charged by a refueling machine comprising a pressure container with an outlet that may be coupled with each of the charging holes, which are in alignment with the horizontal fuel channels in the core of the reactor. Between the biological shielding and the core an air gap is provided forming a header for the coolant circulating in the channels, while a horizontal charging chute connects the charging hole with the corresponding channel. A plug normally closes the charging hole and is extended at its inner end by a push-rod adapted to push the fuel elements during the charging operation into the channel. The charging machine is first coupled with the charging hole; the plug is then coupled with a bar supported by a carriage movable along the channel axis; the plug may then be withdrawn into the machine to a position behind a rotatable cylindrical magazine, having cells containing fuel elements adapted to be placed successively in alignment with the push-bar of the plug, which then pushes the element into the channel. (NPO)

28498 CHARGING CHUTE FOR FUEL ELEMENTS OF A NUCLEAR REACTOR. (to The English Electric Co. Ltd.). French Patent 1,257,527. Feb. 20, 1961.

An articulated charging chute is described that can serve a group of channels. The chute is composed of a main tube rotatably mounted in the charging hole and fitting at its lower end, via a pivotally mounted nose, in a centering hole provided in the top face of the moderator structure. The main tube has along its lower portion an elongated lateral opening, and a movable tube is pivotally mounted on the main tube near the upper end of this lateral opening, so that the movable tube may swing laterally in order to serve laterally situated channels. A rotary movement of the main tube transmits a drive via a toothed wheel mounted on the centering nose, which engages a gear mounted on the moderator structure. This gear drives a screw in the main tube, inducing by its rotation the axial movement of a nut on this screw. The nut is linked via a lever to the movable tube of the chute, inducing by its axial movement the lateral movement of the tube. (NPO)

28499 IMPROVEMENTS RELATING TO CHARGING AND DISCHARGING MACHINES FOR NUCLEAR REACTORS. (to Metropolitan-Vickers Electrical Co., Ltd.). French Patent 1,258,214. Mar. 6, 1961.

A machine for charging and discharging a nuclear reactor is placed under a reactor core having vertical fuel channels. The machine comprises a structure adapted to rotate around a vertical axis. This structure is preferably enclosed by the reactor pressure vessel and can communicate with a radial passage abutting on the vessel. A fuel element transport device is adapted to be moved through this passage, over rails mounted on this structure and brought into alignment with the passage, into a position at a given distance from the rotation axis. Afterwards the transport device containing the fuel elements may be brought under a predetermined reactor channel by rotation over a given angle. The charging operation from the transport device into the reactor channel is preferably controlled by the rotation around the same axis of a second mechanical structure. Radial bars of this second structure engage a toothed wheel mounted in the transport device. The rotation of this wheel controls the charging mechanism incorporated in the transport device. (NPO)

28500 REMOVABLE FLUID TIGHT CLOSURE MEANS FOR A HOLE PROVIDED IN A WALL SEPARATING TWO FLUIDS, IN PARTICULAR INSIDE A NUCLEAR REACTOR. (to Siemens- Schuckertwerke A. G.). French Patent 1,259,846. Mar. 20, 1961.

Means for fluid-tight closure of a hole comprises closure pieces inserted into the channel forming the hole, so that the force pressing sealing surfaces of the closure pieces against sealing shoulders provided in the wall and in the closure piece, if both are at the same temperature. In order to achieve this stress, the channel wall and the closure piece are preferably made of materials having different coefficients of thermal expansion. The closure piece is fixed to the hole by any fixture taking up the reaction force of the sealing force. At least one of the two constituents (viz. the channel wall and the closure piece) is heated or cooled during the placing of the closure piece. (NPO)

28501 MEANS FOR PREVENTING THE BLOWING OUT OF FUEL ELEMENTS DURING THE REFUELLING OPERATION OF A NUCLEAR REACTOR COOLED BY PRESSURIZED GAS. (to Société Indatom). French Patent 1,260,206. Mar. 27, 1961.

In nuclear reactors where the pressurized gaseous coolant flows upward through the reactor channel, the pressure drop in the channel during refueling is sufficient to blow out some of the elements when the top ones are removed. In order to prevent this occurrence, the maximum gas flow is artificially restricted by an annular chamber positioned around the charging chute during the refueling operation. This chamber communicates via lateral openings in the wall of the charging chute with the inside of the charging chute, so that a gas flow from the reactor channel passes through the chamber. Gas leaves the chamber via circular openings in its top wall. Inside the chamber, balls are guided in the direction of the chamber axis, so that an increased gas flow may lift the balls and press

them against the top openings in order to close them. The balls have different densities so that the balls close a number of openings that depend on the intensity of the gas flow. (NPO)

28502 IMPROVEMENTS RELATING TO NUCLEAR REACTORS HAVING A SOLID MODERATOR. (to Commissariat à l'Énergie Atomique). French Patent 1,260,603. Apr. 4, 1961.

The outer surface of a pile with a graphite moderator structure is stiffened by several stakes, these stakes being fixed at both their upper and their lower ends, so that one of these fixations is constituted by a ball-and-socket joint, all the joints described are mounted on the same rigid annular member. The materials of the members on which the stakes are fixed have, in the range of the working temperature, about the same degree of thermal expansion. The stakes are preferably constituted by hollow steel bars filled with neutron-moderating or -reflecting material and are connected with the pile by radial keys. These stiffening means are preferably used for a pile comprising vertical columns of graphite bars, adjacent columns being mutually connected by radial keys fitted in radial grooves provided in the lateral surfaces of the bars. (NPO)

28503 DEVICE FOR MECHANICAL TRANSMISSION THROUGH A FLUID-TIGHT WALL. (to Commissariat à l'Énergie Atomique). French Patent 1,260,628. Apr. 4, 1961.

In nuclear reactors it is sometimes necessary to remove the control rod mechanism for maintenance purposes. A control rod mechanism is described that comprises a mechanical transmission through a fluid-tight wall enclosing the reactor. This control rod mechanism is adapted for a swimming pool reactor with control-rod actuation from below. The control rods are connected at their lower end to a valve that is fitted to close, in the lowermost position of the rod, the channel that generally effects the communication between the control rod channel and the space in which the control rod mechanism is positioned. The lower end of this valve body is connected via a bayonet joint with the control mechanism, so that the latter may be removed when the valve is closed in the lowermost position of the rod, and fluid losses from the pool may thus be prevented. (NPO)

28504 MODERATOR STRUCTURE FOR NUCLEAR REACTORS. (to The English Electric Co., Ltd.). French Patent 1,261,104. Apr. 4, 1961.

Extruded graphite bars show mutually perpendicular axes of maximum and minimum Wigner growth. A moderator structure for a nuclear reactor is described that comprises bricks of extruded graphite bars. The bricks are arranged in a plurality of columns, so that all the bricks of the same column have the same direction of respective maximum and minimum Wigner growth. These directions are perpendicular to the axis of the reactor channels generally traversing all the bricks of the column in question. The directions of maximum and minimum Wigner growth of adjacent columns are mutually perpendicular, so that the variation of the dimensions of the whole structure caused by the Wigner growth in a direction perpendicular to the axis of the reactor channels is proportional to the average rate of growth for an individual brick. Preferably the bricks of adjacent columns are disposed so that they do not have their bases at the same levels. (NPO)

28505 NUCLEAR REACTOR WHEREBY THE FUEL IN THE SHAPE OF BALLS OR THE LIKE IS POURED INTO THE REACTOR CORE. (to Brown, Boveri & Cie A. G. and Beteiligungs- und Patentverwaltungsges.m.b.H.). French Patent 1,265,484. May 23, 1961.

In a nuclear reactor, fuel in the shape of balls may be poured into the core-space via a central opening at the top of the reactor, this core-space being bounded by reflector walls. A device is described whose top reflector, closing the top of the core-space, has a cone-shaped inner surface, so that this surface is parallel to the upper cone shaped surface of the piling of the fuel balls. Preferably the distance between these parallel surfaces is about one to three times the fuel ball diameter. The top reflector is movable in vertical direction according to the quantity of fuel charged. (NPO)

28506 NUCLEAR REACTOR WHEREBY THE FUEL IN THE SHAPE OF BALLS OR THE LIKE IS POURED INTO THE REACTOR CORE. (to Brown, Boveri & Cie A. G. and Beteiligungs- und Patentverwaltungsges.m.b.H.). French Patent 1,265,485. May 23, 1961.

In a nuclear reactor into which ball-shaped elements are poured forming in the core-space a piling cooled by a gas stream entering the core-space at the bottom and leaving it at its top, means are provided to prevent the lifting up of the uppermost balls caused by the elevated flow velocity of the hot gas in the uppermost core region. These means consist in increasing the cross-section of the core-space with height, such that the velocity of the gas remains constant during its passage through the reactor core, or preferably decreases in the top region. (NPO)

28507 NUCLEAR REACTOR FUEL. Myron B. Reynolds (to General Electric Co.). U. S. Patent 3,043,761. July 10, 1962.

A reactor fuel solid is described in which loss of thermal conductivity due to random fracturing of the fuel is prevented. The fuel solid is provided with longitudinal V-shaped grooves in the interior or on its outside surface, so that thermal stresses induce only cracks parallel to the heat conduction path. Examples of the fabrication of UO_2 extrusions in this manner are given. (D.L.C.)

28508 REACTOR CONTROL ROD ACTUATING SYSTEM. Cecil G. Martin and Harold H. Humpal (to Thompson Ramo Wooldridge Inc.). U. S. Patent 3,043,762.

An external thimble-type control rod actuating system for pressurized water reactors is designed which is operable at different speeds. The system comprises a piston connected to the control rod with movement controlled by fluid pressure acting on opposite sides of the piston. (D.L.C.)

28509 APPARATUS FOR LOADING AND UNLOADING A MACHINE. John H. Payne, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,044,947. July 17, 1962.

An arrangement for loading and unloading a nuclear reactor is described. Depleted fuel elements are removed from the reactor through one of a small number of holes in a shielding plug that is rotatably mounted in an eccentric annular plug rotatably mounted in the top of the reactor. The fuel elements removed are stored in a plurality of openings in a rotatable magazine or storage means rotatably mounted over the plugs. (AEC)

28510 FUEL CONTAINER CLOSURE. Cecil C. Stone and Robert A. Noland (to U. S. Atomic Energy Commission). U. S. Patent 3,045,108. July 17, 1962.

A method of producing a spherical closed end on a small thin-walled tube forming a container for reactor fuel is described. An end cap inserted in the tube has a long slender external projection extending axially of the

tube. A heavy electrical current is applied to the projection, and simultaneously a portion of the tube very near the end cap is chilled. A part of the projection is vaporized, and the balance is melted, along with portions of the end cap and the tube. As a result, the end cap is welded to the tube, and the projection in melting is spread out to form a spherical surface on the end cap. (AEC)

28511 NUCLEAR REACTOR. Cleve R. Anderson (to U. S. Atomic Energy Commission). U. S. Patent 3,046,212. July 24, 1962.

A fluidized bed nuclear reactor and a method of operating such a reactor are described. In the design means are provided for flowing a liquid moderator upwardly through the center of a bed of pellets of a neutron-fissionable material at such a rate as to obtain particulate fluidization while constraining the lower portion of the bed into a conical shape. A smooth circulation of particles rising in the center and falling at the outside of the bed is thereby established. (AEC)

28512 STEAM REACTOR SYSTEM. Gale J. Young and David M. Poole (to United Nuclear Corp.). U. S. Patent 3,047,479. July 31, 1962.

A method was developed for utilizing heat energy produced by the fission process occurring in a power reactor. It consists of passing an easily vaporizable and condensable medium in its vaporous phase through the reactor in heat exchange relation to at least a portion of the reactor to heat the vaporous medium, condensing at least a portion of the heated medium, transforming the condensed medium to its vapor phase by mixing it with a portion of the heated medium, and recirculating the transformed medium. (M.C.G.)

28513 NUCLEAR ENERGY REACTORS. Henri Polak. U. S. Patent 3,047,483. July 31, 1962.

In order to provide a reactor in which the fuel itself provides the means of heat transfer from the reaction zone to the cooling zone without the use of liquid fuel, the fuel-bearing elements were designed in suitable shape and then rotated systematically so that each portion of the fuel passed alternately through the reaction zone and through a cooling zone. By shaping the fuel elements to possess substantially axial symmetry, continuous energy release and heat transfer at a constant rate were achieved. The disc-shaped fuel-containing elements were mounted for rotation about their respective centers in a plurality of spaced parallel planes. (M.C.G.)

28514 SAFETY ARRANGEMENT FOR NEUTRONIC REACTORS ABOARD WATER-SUSTAINED CRAFT. Cecil B. Ellis (to Foster Wheeler Corp.). U. S. Patent 3,047,485. July 31, 1962.

A safety system was developed for reactors aboard water-sustained vessels. The system consists of a shield, a fluid-tight compartment within the shield with the wall being spaced from the shield to define a water channel disposed below the level of the sustaining water, and a conduit means with inlets connected between the water channel and the water outside the vessel. Decay heat liberated by the reactor fuel after reactor shut-down causes a natural circulation of water through the channel and conduit to remove the decay heat from the compartment. (M.C.G.)

28515 NUCLEAR REACTOR. George H. Hanson (to Phillips Petroleum Co.). U. S. Patent 3,047,486. July 31, 1962.

A reactor which employs rotating plates which contain fissionable material is described. These plates are mounted with respect to one another so that there is an overlapping of sections of the plates at a common location. The composition of the plates and the positions of the plates are such that a self-sustaining reaction takes place in the overlapped region. Due to the heat capacity of the fuel plates, a substantial amount of heat is carried by the rotating plates out of the overlapped area. A coolant is circulated in heat exchange relationship with the plates to remove the generated heat. (M.C.G.)

28516 SOLID FUEL AND HEATING ELEMENT FOR GAS-COOLED NUCLEAR REACTORS. Guy H. Cannon (to Dow Chemical Co.). U. S. Patent 3,047,487. July 31, 1962.

An assembly of interlocked wedge S-shaped fuel elements was developed for gas-cooled reactors. The fuel element legs were of substantially equal length and width, but contained an uneven distribution of nuclear fuel. The thicker leg of one element was interlocked with the thinner leg of the next element so that more of the fuel mass was positioned near the coolant inlet and less near the coolant outlet. (M.C.G.)

Power Reactors

Refer also to abstract 27246.

28517 (ACNP-6121) PATHFINDER ATOMIC POWER PLANT. SUPPLEMENTAL TECHNICAL INFORMATION. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). [nd.] For Northern States Power Co., Minneapolis. Contract AT(11-1)-589. 44p.

Technical information concerning components of the Pathfinder reactor to be fabricated of precipitation-hardened stainless steels is presented. Included are drawings and specifications concerning control rod drive mechanisms, pressure vessel components, and core structure and support assemblies. Details of an inspection program are included. (J.R.D.)

28518 (ACNP-62012) PATHFINDER ATOMIC POWER PLANT TECHNICAL PROGRESS REPORT, JANUARY 1962-MARCH 1962. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). June 30, 1962. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 81p.

Progress is reported on the research and development program being performed in connection with the design of the Pathfinder Atomic Power Plant. The topics covered include: fuel material cladding, bonding, and irradiation testing; heat transfer and fluid flow; fuel element manufacturing research and development; low-enrichment superheater fuel element design; mechanical studies of control rods, guide tubes, and control rod drives; reactor physics; and reactor and system dynamics. (C.H.)

28519 (APAE-65) INTERIM REPORT OF NUCLEAR ANALYSIS PERFORMED ON SM-2 CORE AND VESSEL, SEPTEMBER 1, 1958–DECEMBER 31, 1959. P. E. Bobe, ed. (Alco Products, Inc., Schenectady, N. Y.). May 27, 1960. Contract AT(30-3)-326. 405p.

A report is presented which is intended to serve as a cumulative data source for nuclear analysis work being performed under Task 10 of the SM-2 Core and Vessel program. Information is included on calculational models for determination of reference loading steel vs water reflector and non-uniform burnout of core. Information is also included on the nuclear design of a two-pass core, effects of design changes on the SM-2 core, and SM-2 reactor core and vessel design. Calculations are presented concerning control rods, flux and power distribution, critical experiments, microscopic cross sections, and treatment of control rods and fuel elements in the core. The IBM-650- and 704-codes employed are described. (J.R.D.)

28520 (APAE-116) SILVER–CADMIUM–INDIUM ABSORBER DEVELOPMENT. R. A. Shaw and R. L. Harris (Alco Products, Inc., Schenectady, N. Y.). June 13, 1962. Contract AT(30-1)-2639. 31p.

Development of an Ag–Cd–In alternate absorber section is described for Army Type SM reactors. The absorber material composition and the geometric configuration are described, and the nuclear and thermal analyses supporting this configuration are given. A detailed description of the manufacturing practice employed in fabricating the final design component is also included. (auth)

28521 (APAE-Memo-305(Suppl.1)) MEASUREMENTS AND CHANGES ON SM-1 CORE II DURING PERIOD OCTOBER 1, 1961 TO MAY 30, 1962. F. G. Motte, W. C. Frost, and J. D. Kortheuer (Alco Products, Inc., Schenectady, N. Y.). July 3, 1962. Contract AT(30-1)-2639. 44p.

Tests at the SM-1 reactor are reported for the period October 1, 1961, to May 31, 1962. Loading changes were made in SM-1 Core II during the scheduled semiannual shutdowns in October to November 1961 and April to May 1962. Core physics tests include control rod bank calibrations, bank position at several temperature and xenon poison conditions vs core changes and energy release, shutdown neutron source decay and startup channel testing, and critical rod positions for stuck rod configurations. Shielding measurements of gamma radiation in the rod drive pit were made, and dose rates from spent fuel elements as a function of the depth of the water shield were obtained. A lift mechanism for the BF_3 detector of one startup channel was installed and preliminary testing completed. Water chemistry and radiochemistry tests included a changeover to high pH for the primary coolant, fission product monitoring for iodine, measurement of dose rates in primary system during shutdown, radiochemical analysis of primary water and crud, and change of metal corrosion samples. Buildup of radioactivity in the demineralizer was monitored by radiation surveys and film badge exposures. (auth)

28522 (APAE-Memo-315) PRIMARY SHIELD OPTIMIZATION SURVEY FOR THE PL-3 REACTOR. J. F. Foulon and A. N. Crouch (Alco Products, Inc., Schenectady, N.Y.). June 28, 1962. Contract AT(30-1)-2900. 103p.

A detailed study of four reactor and shield configurations was made. Two basic reactor types, the boiling water and pressurized water reactors were considered. Shield materials of lead-water and iron-water were used with varying thicknesses for determining the optimum shield configuration for the PL-3 reactor. Also presented is a survey of available shielding codes. (auth)

28523 (APAE-Memo-316) SELECTION OF CORE DESIGN NO. 1 FOR TYPE 5 REPLACEMENT CORES IN SM-1 AND SM-1A. S. L. Davidson and S. Paluszkiewicz (Alco Products, Inc., Schenectady, N. Y.). July 3, 1962. Contract AT(30-1)-2639. 63p.

Nuclear and thermal analyses were performed to determine the characteristics of the Type 5 core in the SM-1 and SM-1A reactor plants as a function of geometry and composition. The following nuclear properties were investigated: core energy release, maximum midlife reactivity, average fuel burnup fraction, B-10 reactivity coefficient, and power distribution. Thermal parameter surveys determined the effects of channel thickness and power distribution upon the DNBR, nominal and hot channel thermal performance, and fuel plate thermal stress. From the nuclear and thermal analyses, a Type 5 core reference design was selected with fuel plates of 70-mil plate thickness, 7-mil clad thickness, and 38 wt % UO_2 in the matrix, having initial core loading of 108 Kg U^{235} and 260 gm B^{10}. (auth)

28524 (APEX-725) FINAL STATUS OF GENERAL ENGINEERING LABORATORY AIR FLOW AND DUST TEST PROGRAM. PART I. Walter F. Venneman. PART II. R. L. Lawrence and P. T. Ryan (General Electric Co. General Engineering Lab., Schenectady, N. Y.). May 25, 1961. For General Electric Co. Flight Propulsion Lab. Dept., Cincinnati. Contracts AF33(600)-38062 and AT(11-1)-171. 32p.

A full scale 15° sector of the P122 reactor configuration was constructed. The model was complete with respect to all internal cooling air passages, and reflectors, thermal shielding, and island reflector. The contract was terminated before any test data could be obtained. Investigation of the effect of atmospheric dust on performance of reactor systems using wire screen matrix fuel elements is reported. The interim conclusion is that dust would not limit aircraft performance or life. Work proposed but not completed is outlined. Appendices contain previously unpublished reports. (auth)

28525 (APEX-800(Pt.B)) GAS-COOLED HIGH-TEMPERATURE NUCLEAR REACTOR DESIGN TECHNOLOGY. 4. CELLULAR METALLIC FUEL REACTORS. R. G. Cook, M. B. Goldstein, C. W. Moon, and W. Z. Prickett (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). June 30, 1962. Contract AT(11-1)-171. 271p.

Design technology for gas-cooled high-temperature nuclear reactors is described. Particular emphasis is placed on the design of cellular metallic fueled, hydrogen moderated reactors. The information is presented in sections concerning reactor configuration key considerations, and thermal, nuclear, and mechanical design. (J.R.D.)

28526 (ARF-4226-1) PRESSURE SUPPRESSION AND CONTAINMENT LABORATORY FACILITY. PHASE I. PLANNING. E. V. Gallagher (Illinois Inst. of Tech., Chicago. Armour Research Foundation). June 1962. Contract AT(11-1)-938. 292p.

An experimental program to study the phenomena involved in loss-of-coolant accidents of water cooled power reactors is proposed together with the preliminary design of a laboratory facility. The background of previous work by others on this problem is reviewed and a technical discussion is given for the various analytical models and phenomena which are, or may be, important to the determination of pressure in the containment vessel and the dissipation of coolant energy following accidental rupture of the primary coolant system. Attention is restricted to the fluid flow, thermodynamics, and heat transfer aspects of the reactor containment system; the mechanical response, and chemical reactions, of the system are excluded from this study. An extensive review of two-phase flow in channels presented in Appendix A deals primarily with methods which have been suggested for predicting the mass flow rate. No proven satisfactory method presently exists for either predicting or measuring the transient mass flow rate of water and steam from the reactor but techniques for both measurement and analytical prediction are discussed and included in the proposed experimental program. Heat loss from the coolant to the containment vessel and other solids, as well as to water sprays or pools, is included in both the analytical models and the proposed experiments. The experiments proposed begin initially with simple flow systems using nitrogen pressurization to prevent flashing in the primary system. Other proposed experiments deal with complex conditions of unsteady flash-

ing, perturbations in the flow system, heat sinks, pressure relief, and various simulations of prototype essential features. Experiments covering an estimated operation time of about two to four years are proposed. It is believed that the proposed program will provide satisfactory understanding of the phenomena involved to confirm or develop analytical models which will be the basis for confident design application. The recommended laboratory apparatus consists mainly of two pressure vessels: (1) a 4200 ft^3, 70 psi containment vessel and (2) a 33 ft^3, 2400 psi source vessel. Other items required include buildings, an overhead crane, instrumentation, and miscellaneous water tanks, piping, heating equipment, pumps, etc. Laboratory sites recommended consist of one in Chicago and an alternate site in Gary, Indiana. The estimated time for design and construction of the facility covers a period of 14 months. (auth)

28527 (CEND-150(Pt.II)) ADVANCED INDIRECT CYCLE WATER REACTOR STUDIES FOR MARITIME APPLICATIONS. PART II. PLANT CONCEPTUAL STUDIES. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Mar. 1962. Contract AT(30-1)-2709. 134p. (NYO-9949(Pt.II))

The results of conceptual studies of indirect cycle reactor plants which will be useful in early cooperative programs between the U. S. Atomic Energy Commission and the U. S. Maritime industry are presented. An earlier design of a pressurized water plant for a large tanker was improved, based on both the latest information available from operating reactors and the information available from various Commission-sponsored research and development programs. An economic analysis of this updated version was made. The value of improvements made in consolidation of components, simplification of plant controls, and elevation of system temperature, which were achieved in part through the adoption of self-pressurization, was assessed. Although a significant cost reduction resulted, this reference plant is not yet competitive with oil-fired marine boilers. Further development to extend these and other present-day concepts is needed. The effect on plant costs of reducing the primary system design pressure of the new reference plant from 2500 psi to 1600 psi was determined. In this study, the cost reduction due to lighter components and thinner fuel cladding was compared with the increased cost for a larger heat transfer area and a greater core power output required by the use of a lower system temperature. A slight cost savings was computed for the lower pressure plant, but it might not be real since the adverse effect of an increase in containment size upon the ship structure could not be fully assessed. Consequently, it was concluded that neither the high nor low pressure plant possessed a clear-cut cost advantage for this particular application. An investigation of methods for improving the reactor plant through a reduction in instrumentation and control requirements was made. A concept of a minimum attention plant, in which use is made of inherent natural responses for systems control, was developed to meet the goal of reduced attention from the crew, while realizing a cost savings from the resulting simplification. The concept was found feasible. Accordingly, it was recommended that a conceptual design of a whole plant be made to determine the extent to which the goals can be attained and to estimate the cost for such a plant. (auth)

28528 (DC-55-11-91) ANALYSIS OF THE CONDITIONS IMPOSED UPON CONCENTRIC RING TYPE FUEL ELEMENTS DURING TESTS IN THE BURNER RIG. General Engineering Development Report No. 138. J. Holowach (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Nov. 15, 1955. Contract AT(11-1)-171. 27p.

A series of tests was conducted with concentric ring type fuel elements to determine if a last stage element when being structurally tested in the burner rig was subjected to test conditions which were more severe than those which the element would encounter during actual reactor operation. These tests showed that a single stage being tested alone will not be subjected to a greater frictional drag load, but will be subjected to a greater form drag load. This greater form drag is due to a static pressure drop associated with the velocity profile change (flat at inlet to approximately parabolic at exit) occurring within a single stage element or the first stage of a series of elements. The element will also be subjected to abnormal lift forces caused by the redistribution of the velocity profile immediately upstream of the first stage. It is necessary, therefore, that a test of a last stage element have a buffer (or flow straightener) located just upstream of the stage under test. This buffer should have the same plate thickness and plate spacing as the stage being tested and the interstage gap should be equal to that to be used in reactor operation. (auth)

28529 (GEAP-3818) CONSUMERS BAFFLE TWO-PHASE AIR-WATER FLOW TESTS IN A ONE-FIFTH SCALE MODEL. C. L. Swan (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 1961. Contract AT(04-3)-361. 26p.

Model tests of the asymmetrical Big Rock Plant riser configuration were performed in an air-water loop. The asymmetrical riser configuration, dictated by the position of the steam drum, created a problem of slugging in the reactor vessel and risers. Slugging in the risers was caused by alternate covering and uncovering of the riser nozzles by the fluctuating water level in the vessel. This fluctuating level was caused by the non-symmetrical flow patterns resulting from the two-phase mixture being removed from only one side of the reactor vessel. Several baffle plates were tested to alleviate this slugging problem. Their performance was determined from high speed color movies taken of each configuration. A flat plate with an octagon shaped hole large enough to permit reloading the 75 MW core without removing the baffle was installed in the vessel flush with the top of the riser nozzles. Insufficient damping of the vessel water level resulted in slugging of the two-phase mixture in the risers. Slugging in the two end risers was especially severe due to a vortex formed immediately below the baffle plate on the non-riser side of the vessel. Several methods of eliminating the vortex by means of vertical and horizontal baffle plates were tried, but the results were not favorable. Decreasing the size of the hole in the baffle plate resulted in improved control of the water level, but the slugging induced by the vortex was not significantly reduced. A downward projecting cone similar to the type currently employed in reactors with symmetrical risers was tested with very unsatisfactory results. The two-phase mixture caused a build-up of voids on the non-riser side of the vessel and violent slugging resulted in the two end risers. A flat, solid plate located flush with the top of the risers resulted in a significant decrease in the slugging and vibration in the risers. By bending down a portion of the plate on the non-riser side of the vessel, the vortex, which still remained, increased the velocity of the two-phase mixture downward and forward towards the center risers. This resulted in a uniform distribution of the two-phase mixture to all risers and an elimination of riser vibration caused by slugging. To permit instrumentation leads and possible reloading of the core

without removal of the baffle plate, a series of tests were conducted to determine the maximum size opening in the baffle plate. Tests indicated that a centrally located hole 20 inches in diameter could be used without materially affecting the performance of the baffle plate. (auth)

28530 (GEMP-107) 630A MARITIME NUCLEAR STEAM GENERATOR SCOPING STUDY. Summary Report. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Mar. 5, 1962. Contract AT(40-1)-2847. 41p.

A summary is presented of the results of a study of a nuclear steam generator which uses reactor technology developed during the aircraft nuclear propulsion program to produce superheated steam for marine propulsion. This system was first proposed to the Atomic Energy Commission in June 1961, and was one of the results of an effort initiated in April 1961, following the cancellation of the ANP program, to investigate other applications of the technology developed. Reviews with members of the Atomic Energy Commission and the Department of Defense Agencies established directions of interest for these studies. (auth)

28531 (GEMP-108) 630A MARITIME NUCLEAR STEAM GENERATOR SCOPING STUDY. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 15, 1961. Contract AT(40-1)-2847. 222p.

Results of a study are presented of a nuclear steam generator which would be developed using the reactor technology developed during the aircraft nuclear propulsion program. The reactor could be used to produce superheated steam for marine propulsion. The generator for which a design is presented is designated 630A. It consists of a water-moderated air-cooled reactor, a boiler, shielding, and accessory equipment. The coolant air is contained throughout a closed cycle in the fully shielded reactor pressure vessel. (J.R.D.)

28532 (GNEC-220) NUCLEAR SUPERHEAT DEVELOPMENT PROGRAM. Tenth Quarterly Progress Report, October–December 1961. (Combustion Engineering, Inc., Windsor, Conn. and General Nuclear Engineering Corp., Dunedin, Fla). Contract AT(11-1)-795. 154p.

Details of final reactor assembly are being generated in preparation for issuing the final report on the reference design with double-annular fuel elements. The central boiler-superheater region contains 1098 fuel elements arranged on a uniform pitch throughout the entire region, with periodic elements being replaced by control elements. A fuel-shuffling scheme was selected which will be used in replacing one-third of the core at the end of each 5000 Mwd/t time step. Fuel removed from the core at the end of a time step will have had 3 cycles of service. A nuclear analysis revealed that the total peaking factor in the boiler region is 1.68, including the effect of the central water channel, deliberately introduced in a location designed to minimize the total peaking factor. The plant control system is designed to enable integration of the plant in an electric distribution system and to protect the superheater in shutdown. Fabrication of 105 compacted UO_2 fuel elements is reported with a density of about 84% of theoretical. Determination of parameters concerned with departures from designated locations for steam tubes was made. Criticality and power distribution measurements were made on three core configurations using multitube fuel elements on triangular lattices; one of the lattices simulates a reactor at 975°F containing an average void fraction of 17.4%. Materials for the developmental program with alternate materials for fuel element are on order. Inconel and Hastelloy-X are alternates for Inconel-X. (J.R.D.)

28533 (HW-73030) PRTR AUTOMATIC CONTROLLER—REVIEW OF DESIGN ANALYSIS AND PRE-OPERATIONAL TESTING WORK AND REPORT BIBLIOGRAPHY. H. K. Nelson (General Electric Co. Hanford Atomic Products Operations, Richland, Wash.). Mar. 20, 1962. Contract AT(45-1)-1350. 120p.

A review of the PRTR automatic controller is made including brief outlines of the original design philosophy and operational requirements, design and purchasing history, design audits, and pre-operational testing. The automatic control system, which has not been tested in actual control of the reactor, is used for startup, steady state, and shutdown operation. (N.W.R.)

28534 (HW-SA-2058) PCTR MEASUREMENT OF THE EGCR CONTROL ROD STRENGTH. P. F. Nichols, T. J. Oakes, and R. E. Heineman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [1960]. Contract [AT(45-1)-1350]. 17p.

The Experimental Gas Cooled Reactor (EGCR) control rod worth was measured in the Physical Constants Testing Reactor (PCTR). The reactor parameters measured are the infinite multiplication factors for a uniform array of EGCR fuel cells, and the infinite multiplication factor for a control rod supercell. The control rod supercell consists of an array of sixteen EGCR fuel cells with a boron carbide control rod fully inserted in the center of the array. These measured parameters may be compared directly with cell calculations. Their difference is defined as the control rod worth. The result obtained for the control rod used in this experiment is $\Delta k_{\infty}^{cr} = 0.158 \pm 0.012$ for a four by four array of fuel cells. The theory of such measurements in the PCTR is discussed in both the one and the two group approximations. (auth)

28535 (KAPL-M-PPA-40) PASS—A DIGITAL COMPUTER PROGRAM FOR PLANT ANALYSIS STEADY STATE. Betty A. Brown and Keith W. Lallier (Knolls Atomic Power Lab., Schenectady, N. Y.). June 6, 1962. Contract W-31-109-eng-52. 59p.

PASS, a computer program for Philco-2000, evaluates the steady state performance of pressurized water reactor power plants under level ship's attitude and balanced-loop conditions. Equations for temperature and void reactivity, pressure-drop, heat transfer, and subcooled water properties are combined to calculate primary plant temperatures, primary loop flows, secondary steam temperature, and secondary steam pressure. Both natural and forced circulation (with centrifugal or jet pump) operation can be simulated. Specific engineering first order effects are calculated and used as convergence criteria in iterating the simultaneous equations. This procedure was employed to conserve machine time. (P.C.H.)

28536 (LAMS-2720) QUARTERLY STATUS REPORT ON LAMPRE PROGRAM FOR PERIOD ENDING MAY 20, 1962. (Los Alamos Scientific Lab., N. Mex.). June 1962. Contract W-7405-Eng-36. 22p.

During the report period 110 Mw-hr of operation were completed by LAMPRE I at various power levels, and observations were made of control element performance and reactivity losses. Metallographic examination of a Core I capsule having 120 Mw-hr of irradiation exposure disclosed no major attack. Core II utilizes Ta alloy melts and 13 fuel melts. Starting materials for Core II capsules are tabulated. In research and development a gamma-ray conversion television was used to observe the flow of molten Pu in the PTA experiment. Dilute fuels being studied for use in a high-performance reactor include Pu–Co–Ce alloys, UO_2–PuO_2 paste, and Co–Ru–U. Observations concern-

ing exposure of test containers to U–Pu–Mn fuel at 900°C for 2 hrs are tabulated. In fuel reprocessing data on decontamination of Pu metal by electrorefining and by solvent extraction were obtained. Details of maintenance and development of the core test facility are included. (J.R.D.)

28537 (MND-M-1817) PM-1 NUCLEAR POWER PLANT PROGRAM. Sixth Quarterly Progress Report, June 1, 1960 to August 31, 1960. F. Hittman (Martin Co. Nuclear Div., Baltimore). July 5, 1960. Contract AT (30-1)-2345. 338p.

Progress is reported in the final design modifications, fabrication of plant components, reactor development efforts, and at-site construction work on the PM-1 prepackaged, air-transportable, pressurized water reactor nuclear power plant. The dummy core for gross flow and refueling tests was completed and final preparations were made for the fabrication of the PM-1 power core. Reactor development work included completion of the major portions of the flexible zero-power test experimental program, continuation of the SM-1 and WTR PM-1 fuel element irradiation programs, continuation and completion of major portions of the reactor flow and heat transfer tests, development work on rare earth control rods and power core fabrication, testing, redesign, and completion of the life and reliability tests for the prototype magnetic jack-tpye control rod actuator, and testing, redesign, and completion of the life and reliability tests for the prototype magnetic jack-type control rod actuator. (C.H.)

28538 (NAA-SR-6801) ANALYSIS OF RESULTS OF A SODIUM COLD TRAP EXPERIMENT. J. S. McDonald (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 30, 1962. Contract AT (11-1)-GEN-8. 31p.

The use of sodium reactor system fill and drain tanks as devices for the purification of the reactor coolant should lead to reduced reactor capital and maintenance costs. To explore the feasibility of such a purification scheme and to obtain quantitative information on the subject, an experiment was conducted using a 4 ft diam by 8 ft long tank in a circulating sodium system. Two processes were investigated: (1) batch or simple crystallization, and (2) circulation cold trapping employing an economizer and oxide storage bin positioned within the tank. Experimental results for (1) were satisfactory and an empirical correlation was obtained which gives oxide level as a function of time, initial conditions, sodium depth, and folding time of the sodium cooling; process (2) was found to be unsatisfactory with the system as designed. An analysis using oxide plugging information from the batch process studies resulted in obtaining a crystal population-size distribution function. (auth)

28539 (NAA-SR-Memo-7294) MODIFYING SRE HEAT TRANSFER SYSTEMS TO PERMIT 30-MWT OPERATION. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 13, 1962. Contract AT(11-1)-Gen-8. 49p.

A description is presented of an intermediate step in a proposed conversion of the SRE from its present capability to an advanced prototype (40 Mwt, 1200°F outlet Na temperature). The modifications described would permit maximum reactor power to be raised to 30 Mwt at an outlet temperature of 1200°F, with steady state operation at 26 to 30 Mwt and 1200°F. With a few changes the 40-Mwt power level can be achieved at a later date. (J.R.D.)

28540 (NP-11862) IN-CORE NEUTRON SENSORS FOR NUCLEAR ROCKET REACTORS. Paul E. Brown (Radio Corp. of America. Aerospace Communications and Controls Div., Camden, N. J.). [1962]. 68p.

The close neutron-flux monitoring required for control of a nuclear rocket propulsion reactor, especially under transient conditions of start-up and shut-down, are noted. The NERVA engine must employ a start-up regime in which full power is attained in about 30 sec. Under these conditions, localized differences in flux can be of crucial importance. A discussion is presented which is related to the problems of in-core sensors. Included are sections on flux sensors and standards, factors affecting design, practical neutron sensors, sensor locations and connections, measuring systems, and future development. Information is also included on types of neutron sensors, flux distribution and neutron spectra measurements, and electronic modules. (J.R.D.)

28541 (ORNL-2703) ARMY PACKAGE POWER REACTOR PROJECT PROGRESS REPORT [FOR 1958]. (Oak Ridge National Lab., Tenn.). Apr. 6, 1959. Contract W-7405-eng-26. 90p.

Investigations were conducted on replacing type 347 stainless steel for 304B and 304L as matrix and cladding material in APPR-core 1. The Haynes-25 combs used as flux suppressors in the control rods of core 1 also contributed to the high cobalt activity of the system, and therefore dispersions of Eu_2O_3 in stainless steel were developed for use as flux suppressors. In an effort to provide for operation of core II with a bank of five control rods rather than seven as in core I, means were studies for increasing the boron concentration in the fuel plates. Irradiation tests of fuel plates in the MTR failed to indicate any radiation damage to the specimens even for U^{235} burnup as high as 57%. Methods were developed for fabricating absorber sections for the control rods that consisted of a type 304 stainless steel clad dispersion of 2.86 wt % B^{10} in electrolytic iron. The absorber section developed for core II consists of a roll-clad stainless steel composite plate containing a dispersion of 38 wt % Eu_2O_3 in stainless steel. Experiments were performed in which irradiated fuel plates were melted under controlled conditions simulating the loss-of-coolant accident. A review was made of the critical experiments performed in connection with the APPR-1. Under the Gas Cooled Reactor Program a gas-cooled loop was designed for in-pile testing of advanced fuel specimens in two adjacent lattice positions in the ORR. (W.D.M.)

28542 (SRO-68) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, MAY 1962. (Savannah River Operations Office, AEC). 13p.

Development of the on-power refueling machine for Canadian Deuterium Uranium Reactor (CANDU) is discussed along with boiler test development. Progress made in the development of sintered aluminum products (SAP) is stated. The ultrasonic testing method for fuel element cladding tubes is described. The development of a 19-rod bundle with electrically heated test sections for fluid studies is described. Evaluation of deformation twinning in the plastic deformation of Zircaloy-2 is made along with delayed failure hydrogen embrittlement determination. Critical substitution measurements in the Process Development Pile (PDP) are discussed and described. Fabrication of dummy fuel assemblies for hydraulic testing of the bayonet loops in the Savannah River Components Test Reactor is discussed. Operation data for the Vallecitos Boiling Water Reactor for May 1, 1962, is given. Fabrication development for uranium fuel tubes is discussed. Cost optimization is given for a 300 Mwe heavy water moderated,

organic cooled power reactor. Design development of the Savannah River Components Test Reactor and the Carolinas-Virginia Tube Reactor is discussed and described. (N.W.R.)

28543 (SRO-69) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, JUNE 1962. (Savannah River Operations Office, AEC). 11p.

Research and development progress on heavy-water power reactors is reported. (M.C.G.)

28544 (TID-7623) PROCEEDINGS OF SYMPOSIUM ON SODIUM REACTORS TECHNOLOGY, MAY 24-25, 1961, LINCOLN, NEBRASKA (Division of Reactor Development, AEC and Consumers Public Power District, Lincoln, Neb.). 205p.

Eighteen papers are included; separate abstracts have been prepared for each. Information is given on the status and development of reactor projects and work closely associated with reactor projects in which sodium is used as a heat transfer medium. (N.W.R.)

28545 (TID-7623(p.2-8)) INTRODUCTION AND HISTORICAL SUMMARY. Glen W. Wensch (Atomic Energy Commission, Washington, D. C.).

The history and present status of liquid-metal-cooled reactors, particularly sodium, are discussed. The properties of several reactor coolants including gas, liquid, and liquid metal materials are compared with respect to heat-removal properties, temperature range, heat fluxes attainable, density, thermal neutron cross section, and costs. The advantages of using sodium over other reactor coolants is pointed out. (N.W.R.)

28546 (TID-7632(p.9-32)) EXPERIMENTAL BREEDER REACTOR NO. 2 AND TRANSIENT TEST REACTOR FACILITY. J. L. Koch (Argonne National Lab., Ill.).

The status of the Experimental Breeder Reactor-II (EBR-II) and Transient Reactor Test Facility (TREAT) is pictorially reviewed and discussed. Features of the EBR-II receiving special emphasis are the cooling system employing sodium, core assembly, sodium-to-sodium heat exchanger, plant layout, and fuel element performance. Some of the experimental work being performed using TREAT on the EBR-II fuel elements is discussed. TREAT tests the fuel elements under transient conditions. (N.W.R.)

28547 (TID-7623(p.33-40)) EXPERIMENTAL BREEDER REACTOR NO. 1. M. Novick (Argonne National Lab., Ill.).

The history and status of the Experimental Breeder Reactor are discussed and evaluated. The design and operation of the reactor with the Mark III core receives special emphasis. (N.W.R.)

28548 (TID-7623(p.41-4)) FAST POWER REACTOR EXPERIMENTS IN ZPR-3 WITH METALLIC AND CERAMIC FUELS. F. W. Thalgott (Argonne National Lab., Ill.).

The fast power reactor critical facility, the Zero Power Reactor-III (ZPR-III), is a flexible facility for the study of the important reactor-physics characteristics of fast reactor assemblies. Experiments in ZPR-III with uranium oxide and uranium carbide power-breeder-reactor fuels are discussed. Critical masses obtained with the ZPR-III for these assemblies are compared with calculated results. The core compositions are given for the assemblies. (N.W.R.)

28549 (TID-7623(p.45-51)) ENRICO FERMI ATOMIC POWER PLANT. R. W. Hartwell (Power Reactor Development Co., Detroit).

The status of the Enrico Fermi Atomic Power Plant is discussed and briefly described with respect to construction, fuel requirements and problems, component and preoperational testing, construction permit proceedings, plant organization, and cost. (N.W.R.)

28550 (TID-7623(p.52-62)) LOS ALAMOS MOLTEN PLUTONIUM REACTOR EXPERIMENT NO. 1. R. E. Peterson (Los Alamos Scientific Lab., N. Mex.).

The Los Alamos Molten Plutonium Reactor Experiment No. 1 (LAMPRE-1) is designed to investigate some of the problems associated with the use of a molten plutonium alloy as a fuel for a high-specific-power high-temperature sodium-cooled fast breeder reactor. The experiments will determine the behavior of fission products in such fuels, demonstrate means of reliably containing a molten-metal fuel alloy in a reactor environment, and provide a fast-neutron-flux high-temperature sodium-cooled test facility for examining the characteristics of a variety of possible molten-metal fuel alloys. The design and start-up operation are described along with associated data. (N.W.R.)

28551 (TID-7623(p.63-72)) SODIUM REACTOR EXPERIMENT. L. E. Glasgow (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

Operating experience of the 20-Mw(t) sodium-cooled graphite-moderated low-enrichment thermal reactor for testing the technical feasibility of a large sodium-cooled reactor system operating at high temperature is described. Particular emphasis is placed on the operation and maintenance of the individual systems of the reactor. Results and design descriptions show that the sodium-graphite concept is feasible up to 1000°F. (N.W.R.)

28552 (TID-7623(p.73-88)) HALLAM NUCLEAR POWER FACILITY. R. C. Gerber (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

The status of the Hallam Nuclear Power Facility is covered by discussing the major differences between the SRE and HNPF reactors and by giving a summary of development specifically related to HNPF, a description of the reactor facility, and a schedule of remaining effort. The design of the various components are given for the 80 Mw(e) reactor facility along with operating characteristics of the systems. (N.W.R.)

28553 (TID-7623(p.89-96)) INTEGRATION OF HALLAM NUCLEAR POWER FACILITY INTO CONSUMERS PUBLIC POWER DISTRICT OF NEBRASKA SYSTEM. W. P. Venable (Consumers Public Power District, Lincoln, Neb.).

The integration of the Hallam Nuclear Power Facility (HNPF) into Consumers Public Power District of Nebraska (CPPD) Eastern System is broader than the subject because the Eastern System transmission lines are integrated into the transmission grid covering the eastern two-thirds of Nebraska. The integration systems of the state are shown and the demands and capacity of the sytem are discussed. (N.W.R.)

28554 (TID-7623(p.97-104)) LIQUID-METAL REACTOR DEVELOPMENTS. R. W. Dickinson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

The development programs to reduce cost and increase the reliability of sodium-cooled reactor systems are discussed. The programs have produced important technical advances in sodium technology at temperatures up to 1050°F and these advances are briefly described. (N.W.R.)

28555 (TID-7623(p.105-21)) STATUS WORK ON THE FUEL CYCLE AT ARGONNE NATIONAL LABORATORY. S. Lawroski (Argonne National Lab., Ill.).

Fuel cycle development, particularly as it pertains to the Experimental Breeder Reactor-II (EBR-II), a fast breeder sodium-cooled reactor, is reviewed and discussed. The development work discussed includes information on remote-operating equipment, fuel processing and reprocessing, and fuel element fabrication. The purpose of this work is to develop a fuel element that can be remotely fabricated and reprocessed for adequate removal of undesirable fission products and still produce a fuel that will give high performance in reactor operation. Special emphasis is given to pyrometallurgical processes. (N.W.R.)

28556 (TID-7623(p.122-30)) DEVELOPMENT WORK FOR THE ENRICO FERMI ATOMIC POWER PLANT. A. Amorosi (Atomic Power Development Associates, Inc., Detroit).

The coolant system and fuel element development work for the Enrico Fermi Atomic Power Plant are discussed. Operating experience with the sodium coolant with regards to cleaning operations is discussed by describing cleaning methods and test equipment for the process. Core B fuel-cycle costs are presented. (N.W.R.)

28557 (TID-7623(p.131-4)) FATIGUE TESTS OF SINE-WAVE TUBES. Roy D. Seifert (Alco Products, Inc., Schenectady, N. Y.).

In the design of intermediate heat exchangers and steam generators for high-temperature sodium service, sine-wave tubes are incorporated to care for differential expansion between the tubes and shell. A test rig and method for simulating the desired differential expansion by supporting vertically a tube containing a sine-wave section and forcing the lower end up and down using an air piston are described. Results of fatigue stress at failure for ½-in.-OD type 316 stainless steel tubes are presented. (N.W.R.)

28558 (TID-7623(p.135-48)) STATUS OF FAST OXIDE REACTOR AND SODIUM MASS TRANSFER PROJECTS. Robert W. Lockhart (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.).

The development work being accomplished through the Fast Oxide Reactor and Sodium Mass Transfer Projects is described. The major results from the Fast Oxide Reactor program show that high fuel burnup is possible with oxide and ceramic fuels cooled with sodium, adequate safety characteristics can be calculated, and a technically feasible reactor with a low-cost fuel cycle can be designed. The pertinent details leading to these conclusions are presented. The sodium mass transfer program investigates mass transfer and corrosion of three types of steel loops containing sodium at elevated temperatures. Results show that tolerable corrosion rates are apparent under severe temperatures with pure sodium. (N.W.R.)

28559 (TID-7623(p.149-60)) LOS ALAMOS MOLTEN PLUTONIUM REACTOR EXPERIMENT DEVELOPMENT WORK. W. R. Wykoff (Los Alamos Scientific Lab., N. Mex.).

The LAMPRE program is concerned with the development of plutonium fuels for reactors. Fuel cycles that might achieve optimum over-all efficiency in a fluid-fuel reactor system are discussed. The systems that seem to show promise for use in competitive power plants are contained cores and direct-contact cores. The development work concerned with these cores are discussed with respect to container materials and design, fuel development, corrosion testing, steam-generator facility operation and design, and experimental testing. The operation of the direct-contact reactor system (molten plutonium fuel is circulated in direct contact with the immiscible sodium coolant to effect heat transfer as well as to purge fission gases) is shown to be satisfactory. (N.W.R.)

28560 (TID-7623(p.161-7)) ANALYTICAL METHOD FOR THE DETERMINATION OF OXYGEN IN SODIUM. G. Stern (United Nuclear Corp. Development Div., White Plains, N. Y.).

An analytical method being developed for measuring the low oxygen content produced in sodium from hot-traps is described. The intent of the method is to combine two chemical techniques, the mercury amalgamation method and the Karl Fischer titration method, in such a way to improve sensitivity and to avoid the major sources of error. The main advantage of the method is a complete separation of sodium from sodium oxide is not required. The method will be capable of measuring in the 1 to 10 ppm range for oxygen. The equipment setup is described along with pertinent equipment. (N.W.R.)

28561 (TID-7623(p.168-70)) THE RHAPSODIE PROJECT. John R. Leduc (France. Commissariat à l'Energie Atomique, Paris).

The development program for the French sodium-cooled plutonium-fueled fast breeder reactor, Rhapsodie, is discussed. The program calls for successive operation at 1 and 10 Mw and possibly at 20 Mw. (N.W.R.)

28562 (TID-7623(p.171-200)) PANEL DISCUSSION PRESENT AND FUTURE REACTORS. G. W. Wensch (Atomic Energy Commission, Washington, D. C.); S. Siegel (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.); B. I. Spinrad (Argonne National Lab., Ill.); J. Yevick (Atomic Power Development Associates, Inc., Detroit); E. Jones (Consumers Public Power District, Lincoln, Neb.), and K. P. Cohen (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.).

The sodium-cooled-reactor development programs are discussed in regards to economic and technological progress and problems. (N.W.R.)

28563 (TID-16381) 750eMW ADVANCED GAS COOLED REACTOR POWER PLANT-STEAM GENERATOR STUDY. L. D. Fraley (Combustion Engineering, Inc. Nuclear Components Dept., Chattanooga). June 1962. For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26]; Subcontract 2167. 168p. (CE-1077).

Results are presented of a study on the design and fabrication of steam generators for a 750 eMW advanced gas cooled reactor power plant. Two designs of the continuous tube, once-thru type steam generator with a reheater were investigated. One is with the helium containing cylinder vertical while the other is horizontal. The designs were explored sufficiently to insure the feasibility of shop fabrication. (auth)

28564 (UNC-5019) PAWLING LATTICE TEST RIG—TEST REPORT NO. 3. TABULAR FUEL ELEMENT LATTICES. W. L. Brooks, G. G. Foster, and R. D. Schamberger (United Nuclear Corp. Development Div., White Plains, N. Y.). June 20, 1962. Contract AT(30-1)-2836. 22p.

A summary of experiments in the PLATR with fuel elements made up of concentric tubes of UO_2 is presented. These tubes were fabricated by vibratory compaction. Two types of experiments were performed. Complete k_∞ measurements were made on several lattices, both with and without coolant, and with the coolant voided from the central test section only. It was found that, for a given element, the void coefficient for interior channels does not vary significantly with lattice pitch. The void coefficient for exterior coolant channels is sensitive to lattice pitch

for a given element, and at a constant moderator purity the coolant void coefficient is not a sensitive function of coolant purity. (J.R.D.)

28565 (UNC-5020) PAWLING LATTICE TEST RIG—TEST REPORT NO. 4. LATTICE PITCH VARIATION. W. L. Brooks, G. G. Foster, and R. D. Schamberger (United Nuclear Corp. Development Div., White Plains, N. Y.). June 20, 1962. Contract AT(30-1)-2836. 15p.

A summary is presented concerning tests to evaluate variation of k_∞ with the amount of heavy water moderator in four fuel element configurations of varying lattice pitch. The tests were carried out in the Pawling Lattice Test Rig as a part of the Heavy Water-moderated Power Reactor Program. Experimental results and calculated results, where available, are presented tabularly. (J.R.D.)

28566 (UNC-5022) PAWLING LATTICE TEST RIG—TEST REPORT NO. 5. 19-ROD CLUSTED EXPERIMENTS. W. L. Brooks, G. G. Foster, and R. D. Schamberger (United Nuclear Corp. Development Div., White Plains, N. Y.). June 30, 1962. Contract AT(30-1)-2836. 13p.

A summary is presented concerning experiments on 19-rod clusters of 0.50 in.-dia UO_2 fuel elements involving measurements of k_∞ and thermal utilization. The results of the k_∞ measurements are tabulated. Experiments were also performed in which voids were formed in the interior of the bare cluster and the effect on k_∞ determined without shutting down the reactor. (J.R.D.)

28567 (UNC-5023) HEAVY WATER-MODERATED POWER REACTOR PROGRAM. Quarterly Progress Report for Period Ending June 30, 1962. (United Nuclear Corp. Development Div., White Plains, N. Y.). June 30, 1962. Contract AT(30-1)-2836. 18p.

The series of experiments on 19-rod clusters of half-inch diameter UO_2 rods was completed. Tests were made at four lattice pitches (hexagonal): 7.50 in., 8.46 in., 10.46 in., and 13.22 in. on the bare clusters. At the two smaller pitches the effect of placing shroud tubes around the cluster was determined, and the effect of voiding the coolant inside the tubes was measured. At the 10.46 in. lattice pitch the effect of rod-rod spacing was measured for the bare cluster. In each of the above measurements, values of k_∞ and thermal utilization were obtained. In addition to the complete k_∞ measurements a series of remote voiding experiments was performed on bare clusters to determine the effect of lattice pitch on the void coefficient inside the cluster. The results of all experiments are reported. The results of some theoretical treatments of corrections to the data for the presence of test cans and for the heterogeneity of the lattices are included. In addition, there is a discussion of the relation of the k_∞ value obtained in PLATR to that obtained from buckling measurements. (auth)

28568 (WAPD-TM-265) EVALUATION OF ISOTOPIC CONTENT OF IRRADIATED NATURAL URANIUM DIOXIDE FUEL RODS FROM PWR CORE I. C. D. Sphar (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Feb. 1962. Contract AT(11-1)-Gen-14. 50p.

During the first seed refueling of PWR Core 1, selected natural uranium dioxide fuel elements were removed from the blanket region of the core and destructively analyzed for their uranium and plutonium isotopic content. As part of a program to utilize data provided by plant operations to test nuclear design methods, the experimental data thus obtained are compared with theoretical results calculated using standard fuel depletion techniques. This comparison indicates that no gross misrepresentation exists in the depletion techniques applied to natural uranium. The differences observed appear for the most part to be explainable in terms of the failure of the analytical model to predict the extremes of local variations in neutron flux exposure and in parameters such as the resonance escape probability. (auth)

28569 (AEC-tr-5218) CONFINEMENT OF UNDERGROUND NUCLEAR POWER PLANTS. E. Binggeli and P. Verstraete. Translated from Neue Tech., 3: 352-9(June 1961). 21p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 1258.

28570 (AEC-tr-5223) REACTIVITY POWER EFFECTS AND REACTOR SAFETY. N. V. Krasnoyarov. Translated from preprint SM24/81 presented at the IAEA Symposium on Reactor Safety and Hazards Evaluation Techniques held in Vienna, May 14-18, 1962. 14p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 23330.

28571 (EURAEC-37) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD FEBRUARY 1, 1960 TO APRIL 30, 1960. Quarterly Report No. 2. Part A. Technical Report. (Centro Informazioni Studi Esperienze, Milan). May 15, 1960. Work Performed under United States-Euratom Joint Research and Development Program. Contract 002-59-11RDI. 20p. Translation of CISE-R-20.

Work at CISE during the report period was devoted mainly to the completion of experimental loops and to the development of instrumentation. The heat transfer loop was modified so that it no longer depends on the Emilia Thermal Power Station. A checkout revealed that the facility operates satisfactorily. The flow stability loop was also modified and was pressure tested. Experiments with this loop were started. The corrosion loop is in an advanced construction stage. (J.R.D.)

28572 (EURAEC-39) CAN-1 QUARTERLY PROGRESS REPORT FOR THE PERIOD AUGUST 1, 1960 TO OCTOBER 31, 1960. Quarterly Report No. 4. Part A. Technical Report. (Centro Informazioni Studi Esperienze, Milan). Nov. 15, 1960. Work Performed under United States-Euratom Joint Research and Development Program. Contract 002-59-11RDI. 12p. Translation of CISE-R-28.

Effort during the report period was devoted mainly to heat transfer experiments in annular ducts, collection and study of heat transfer data obtained with the round tubes, refined experiments of flow distribution in the cold argon-water loop, preliminary testing of the instrumentation for study of flow stability, and modification and testing of the erosion and corrosion loop. (J.R.D.)

28573 (FTD-TT-62-620) USE OF GAS TURBINES IN NUCLEAR POWER ENGINEERING. Josef Becvar. Translated from Jaderna energie, 7: 366-73(1961). 19p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract no. 8378.

28574 NUCLEAR POWER REACTOR CONTROL. F. H. Belsey. AEI (Assoc. Elec. Ind.) Eng., 1: Nos. 7-8, 2-12(July-Aug. 1961).

The nuclear characteristics and control systems of graphite-moderated gas-cooled reactors is reviewed. Power and temperature distributions in reactors are considered. Control during startup and manual control systems are described. Control of reactors at temperature and on load is discussed. Analog computer simulation of reactor response is outlined. Instabilities and oscillations caused by automatic control systems are discussed. Temperature control systems are summarized. (T.F.H.)

28575 NEW FUEL ELEMENTS AND STEAM GENERATORS FOR THE SODIUM-GRAPHITE REACTOR. Erwin Tremba. Atom u. Strom, 8: 43-7(June 1962). (In German)

New developments in the technology of uranium carbide and the construction of steam generators have improved the outlook of graphite-moderated sodium-cooled reactors to such an extent that high capacity plants can expect current operating costs of about 6 mills/kwh. The safety and accessibility of sodium graphite reactors was checked by the operation and repair of the Sodium Reactor Experiment. The new developments in fuel element and steam generator technology are reviewed. Then the data for a sodium graphite reactor are given and discussed. (J.S.R.)

28576 OPERATING EXPERIENCE WITH THE PRTR FUEL HANDLING SYSTEM. William E. Cawley and James E. Hard (General Electric Co., Richland, Wash.). Atomics, 15: 22-5(1962).

The Plutonium Recycle Test Reactor and its fuel handling apparatus are described. Problems encountered in the handling of unirradiated and irradiated fuel elements are outlined. Operating considerations and experience with this fuel handling system are discussed. (T.F.H.)

28577 POWER REACTORS—STATE OF DEVELOPMENT AND PLANNING. Peter Engelmann (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirtschaft, 7: 238-46 (May 1962). (In German)

Work being done in the United States, Great Britain, and the Soviet Union on the development and planning of power reactors is briefly reviewed. The significance of these programs in the development of the German research program is discussed. It is concluded that, for the German Republic, the most promising research program would concentrate on pressurized water and boiling water reactors (particularly with superheating), organic-cooled reactors, gas-cooled high-temperature reactors, and heavy water reactors with natural uranium. (J.S.R.)

28578 EXPERIENCES WITH THE HALDEN BOILING WATER REACTOR. J. Asyee. Atoomenergie, 4: 142-7 (July 1962). (In Dutch)

The first phase of the program with the Halden Reactor is past. A description is given of the determination of the steam bubble coefficient. Other experiments being conducted indicate the oscillation void and static void experiments and determination of the steam bubble volume. (tr-auth)

28579 CALCULATION OF THE BEHAVIOR UNDER PARTIAL LOADING OF A NUCLEAR POWER PLANT COOLED WITH GAS AT LOW PRESSURE AND WITH A SINGLE VAPOR CYCLE. Jorge Spitalnik (Instituto of Maquinas de la Facultad de Ingenieria y Agrimensura, Montevideo, Uraguay). Bol. fac. ing. y agrimensura Montevideo, 7: 387-446(Aug. 1961). (In Spanish).

The behavior of a gas-cooled reactor under partial load was calculated for various load regimes according to the different control programs chosen. In the appendix the method used for the calculation of the heat exchange surfaces under full load and the variation of the parameters under partial charge are given. (J.S.R.)

28580 THEORETICAL CALCULATION OF THE SHIELDING OF A 100-Mwe BOILING WATER REACTOR. Ignacio Frisancho. Bol. inform. junta control energía atomica (Peru), 7: 44-56(Mar.-Apr. 1962). (In Spanish)

The factors to be considered in the calculation of the shielding requirements for a 100-Mwe boiling water reactor are given, and the methods used to calculate them are shown. (J.S.R.)

28581 SITE INVESTIGATIONS AT SIZEWELL. G. F. Pedgrift and K. M. Gammon. Consulting Engrs. (London), 20: No. 1, 66-9(July 1961).

From seven Suffolk sites considered for a 580-Mw nuclear power station, Sizewell was chosen. The results of tests of the Sizewell site are summarized. The tests included land boreholes, plate loading tests, offshore boreholes, sea bed surveys, and sea water movement determinations. (D.L.C.)

28582 THE OPTIMUM TEMPERATURE FOR WATER REGENERATION IN NUCLEAR POWER PLANTS HAVING WATER MODERATED AND COOLED REACTORS. Yu. D. Arseniev. Ing. nucleare, 4: 189-94(Sept.-Oct. 1961). (In Italian)

The "base point" method was used to determine the optimum temperature for the regeneration of water with respect to the lowest consumption of electricity. It is possible to prove that a nuclear power plant having a water cooled and moderated reactor has its optimum temperature in the vicinity of the maximum temperature, determined on the bases of the steam parameter after the first turbine stage. Capital investments for the various parts of nuclear power stations were examined on the basis of the regeneration temperatures chosen. (tr-auth)

28583 CHANCES IN IMPROVING SATURATED-STEAM CYCLES OF NUCLEAR POWER PLANTS WITH LOW COOLING TEMPERATURES. F. W. Eckhardt and H. Uschwa (Abteilung Kraftanlagen der Borsig A. G., Berlin). Kerntechnik, 4: 137-40(Apr. 1962). (In German)

The principle of secondary reheating and the possibility of its application to nuclear power stations with low cooling temperatures is described. Overall efficiency and the required sizes of the heat transfer surfaces of the reheaters as a function of steam pressures and resuperheat temperatures are investigated for a 150-Mw OMR nuclear power plant with stated cooling parameters. (auth)

28584 FAST REACTOR ROCKET ENGINES—CRITICALITY. Ralph Cooper (Los Alamos Scientific Lab., N. Mex.). Nuclear Sci. and Eng., 13: 355-65(Aug. 1962).

Critical sizes are determined for a variety of fast assemblies appropriate for nuclear rocket reactors. These are based on cores of UO_2–W cermets or UC-metal carbide solid solutions reflected by beryllium. Rocket reactors weighing as little as 200 lb are possible, and, in larger sizes, either high power density or high exit gas temperature can be achieved. The fast spectrum allows the use of the most refractory materials (such as HfC) in bulk to obtain high performance. Use of U^{233} in place of U^{235} can lead to substantial improvements in reactor weight, specific power, and/or temperature capability at the cost of the radiation associated with U^{233}. The core sizes are generally quite small, which is valuable where shielding may be significant. Nuclear aspects, including control, uranium investment, power distribution, and reflector materials, are briefly discussed. (auth)

28585 THE SELECTION AND INVESTIGATION OF POTENTIAL NUCLEAR POWER STATION SITES IN SUFFOLK. Kenneth Michael Gammon and Gordon Frederic Pedgrift (Central Electricity Generating Board, London). Proc. Inst. Civil Engrs. (London), 21: 139-60(Jan. 1962). (In English)

The engineering aspects of selecting and investigating potential nuclear power station sites in Suffolk for the Central Electricity Generating Board are discussed. The basic technical requirements are discussed, together with the method of selection of sites worthy of investigation, and the limitations of the data available. The potential sites were

situated along 40 miles of coast and their engineering assessment posed a variety of different problems. Conditions ranged from a stable estuary with deep water for cooling purposes close inshore, to an unstable coast with difficult access to adequate water; from poor to good subsoils; from sites suffering severe erosion to one accreting; and with ground levels from cliff tops to saltings. Details are given of the methods used to overcome anticipated and encountered difficulties in investigations. Before the decision was taken to apply for consent to develop the site at Sizewell, additional surveys of possible limitations on ultimate development were undertaken. Subsequent detailed investigations there, to provide for design purposes, involved an intensive study of local conditions and a detailed investigation both on the site and offshore. (auth)

28586 THE REACTOR COOLING BLOWER FOR THE FRENCH NUCLEAR POWER STATION CHINON I. M. Allemann and H. Benz. Sulzer Tech. Rev., Research No. 1961, 69-75(1961). (In English)

The circulating blower handles CO_2 at a pressure of about 25 atm and requires an input of about 9,000 kw. The flow rate is controlled by adjustable inlet guide vanes. The seals on the blower shaft and servomotor spindles are designed to permit replacement under the full pressure of the CO_2 circuit. Experiments are carried out for the purpose of developing and testing new design elements under actual working conditions. (auth)

28587 TECHNICAL AND ECONOMIC POSITION OF DEVELOPMENT OF NUCLEAR POWER PLANTS. Kurt Jaroschek. VDI Zeitschrift, 104: 809-16(June 1962). (In German)

The difficulty in the field of nuclear power plant development lies partly in the fact that the economic field alone cannot be the only consideration, since then future development might be impeded. A technical position has already been reached where, in several constructions, the building of larger nuclear power plants is not only justified, but is even essential to economic operation in the near future. In other constructions, experience has shown that the replacement of water as a coolant by other materials requires the solution of new technological and construction problems. (auth)

28588 IMPROVEMENTS IN OR RELATING TO NUCLEAR INSTALLATIONS AND METHODS OF CONTROL THEREOF. André Huet. British Patent 900,016. July 4, 1962.

A method is outlined for controlling a boiling reactor. The method comprises forming a linkage between the means for controlling the reactivity and a device for controlling the thermal demand of a thermal system associated with the reactor, e.g., a steam flow control valve. The method may be used with a variety of reactivity control systems, e.g., a steam flow control valve. The method may be used with a variety of reactivity control systems, e.g., articulated fuel or moderator rods, moderating liquids, and vibration of coolant, and its use with the reactor described in British Patent 900,015 is described in detail. (D.L.C.)

28589 NUCLEAR BATTERY AND REACTOR. George Michael Safonov. British Patent 900,056. July 4, 1962.

A unit is designed for directly generating electrical energy from fission energy. The unit includes a target electrode, an emitter electrode, a grid electrode between the target and emitter electrodes, and a neutron source. A multiplicity of units may be formed to serve as a battery. Means is provided for refueling the units. (D.L.C.)

28590 A NUCLEAR REACTOR. (to Licentia Patent-Verwaltungs-GmbH). British Patent 903,142. Aug. 9, 1962.

A pressurized light water reactor is designed so that hot spots in zones of high moderator/fuel relative volume are reduced with a corresponding increase in power output. The hot spot reduction is obtained with the addition of absorbers, particularly of Th^{232}, and/or a decreased concentration of fissionable material in these zones. (D.L.C.)

28591 IMPROVEMENTS IN OR RELATING TO SEALING PLUGS. Norman Bradley and Jack Jones (to United Kingdom Atomic Energy Authority). British Patent 903,154. Aug. 15, 1962.

A plug is designed for sealing the bore of a standpipe providing access to the core of a steam-cooled or steam-generating reactor. The plug is of the type wherein a flexible ring, expansible radially by axial loading from a spring to effect a seal, is carried on a plug body with latch members for engaging with the pipe bore, and it is provided with a weighed body so that axial loading from the spring is relieved until the body is supported other than from the plug. (D.L.C.)

28592 HEAT EXCHANGE DEVICE, ESPECIALLY FOR GAS COOLED NUCLEAR POWER REACTORS. (to U. S. Atomic Energy Commission). French Patent 1,236,953. June 13, 1960.

A heat exchange device in a nuclear power plant is described that comprises a double-walled reactor vessel, a double-walled heat exchanger casing, and two coaxial ducts connecting the vessel with the casing, so that the inner duct connects the two inner spaces, while the outer duct connects the outer spaces. In the inner duct hot gas flows from the reactor to the heat exchanger, while it returns to the reactor through the annular space between the two ducts. Preferably the inner duct comprises a telescopic tubular system, allowing its expansion or contraction. It can be centered inside the outer duct by cross pieces which may axially slide inside the outer duct. (NPO)

28593 MERCHANT MARINE SHIP REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,246,458. Oct. 10, 1960.

A nuclear reactor for the propulsion of merchant marine ships is described that comprises a sealed pressure vessel having a top closure and enclosing an active core of a group of vertical fuel assemblies. Each of these assemblies has longitudinal passages to permit a flow of the light water moderator. First and second baffle assemblies are arranged opposite the top and bottom ends respectively of the core. The first baffle assembly includes means for directing the moderator fluid into the longitudinal passages of an outer portion of the fuel assemblies, forming in this manner a downward second pass of the fluid through the reactor. The second baffle assembly includes means for directing outgoing moderator fluid from the outer portion of the fuel assemblies into the remaining inner portion of the fuel assemblies and the spaces in between, forming in this manner an upward third pass of the fluid through the reactor. Means including thermal shielding are provided for directing the moderator fluid entering the pressure vessel along the outside of the reactor core into the first baffle assembly, forming in this manner an upward first pass through the reactor. (NPO)

28594 HEAT TRANSFER SYSTEM FOR NUCLEAR POWER PLANT. Werner Spillmann (to Escher Wyss Aktiengesellschaft). U. S. Patent 3,043,763. July 10, 1962.

A heat transfer system for the nuclear power plant is designed in which a turbine is included in the reactor gaseous coolant circuit for driving the compressor. Two heat exchangers are provided on each side of the turbine

of the coolant circuit for heat transfer from the coolant to the working medium. Thus, the working medium may be heated almost to the outlet temperature of the reactor coolant, while the coolant supplies power to the compressor. Several embodiments of the heat transfer system are described. (D.L.C.)

Production Reactors

28595 (ANL-6299) EBR-II DRY CRITICAL EXPERIMENTS. EXPERIMENTAL PROGRAM, EXPERIMENTAL PROCEDURES AND SAFETY CONSIDERATIONS. L. J. Kock, W. B. Loewenstein, A. Lovoff, H. H. Hooker, H. O. Monson, R. L. Ramp, and E. Hutter (Argonne National Lab., Ill.). Feb. 1961. Contract W-31-109-Eng-38. 86p.

Revisions in the reactor system and operating procedures necessary for carrying out a proposed dry critical experiment in the EBR-II are described. The safety aspect of the program is considered. The critical experiment will be conducted in the EBR-II prior to filling the primary system with sodium. The facility, experimental program, operational and experimental procedures, and hazards and plant safety are described. (M.C.G.)

28596 (HW-65836) TERMINATION REPORT FOR DEVELOPMENT TEST IP-306-K SPLINE COILERS AT K REACTOR. P. B. McCarthy (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 24, 1960. Contract AT(45-1)-1350. 5p.

Spline coilers were installed at KW Reactor and KE Reactor. The use of spline coilers increased the reliability of the spline disposal system. Between 500 and 800 splines were removed with the spline coilers. The exposure rate for personnel using the coiler was much less than the rate with the chopper. Relatively few mechanical and operating problems were encountered. The spline coiler reels gave the most problems and an extensive program is underway to improve the reel design. (auth)

Research Reactors

Refer also to abstract 27044.

28597 (IA-689) ISRAEL RESEARCH REACTOR-I HAZARDS EVALUATION REPORT. J. Tadmor, ed. (Israel. Atomic Energy Commission, Tel Aviv). Dec. 1961. 181p.

Potential hazards in the Israel Research Reactor-I installation are analyzed; the safeguards provided are considered, and the possible effects of a maximum credible accident on the surrounding population and area are evaluated. Events with very small probabilities of occurrence were assumed to be credible. Activity release to the surroundings during normal operation was found to be well within permissible levels. Following an assumed maximum credible accident, the radiation dose levels outside the controlled area would be within reasonable safe values. (auth)

28598 (NAA-SR-7368) SNAP SHIELD TEST EXPERIMENT REACTOR PHYSICS TESTS. R. L. Tomlinson, R. P. Johnson, and S. G. Wogulis (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 15, 1962. Contract AT(11-1)-GEN-8. 30p.

The initial physics tests on the Shield Test Experiment reactor and the precriticality rod-drop test data are presented. (auth)

28599 (NP-11630) EXPERIMENT DESIGN MANUAL AND HAZARDS ANALYSIS FOR NASA. EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES. (Lockheed Nuclear Products, Marietta, Ga.). Sept. 1, 1960. Contract NASw-114. 253p. (NM-111)

Design manual and hazards analysis for the radiation-effects testing of materials at cryogenic temperatures in the NASA Plum Brook Reactor Facility are presented. The testing methods, the equipment to be used at Plum Brook, and the facility modifications necessary for conducting the experiments are described. Calculations are given representing analyses made to support the design of various pieces of equipment and facility modifications. Hazards evaluations are being made for each piece of equipment and facility modification. (M.C.G.)

28600 (NP-11885) MANHATTAN COLLEGE LOW POWER CRITICAL REACTOR. Hazards Summary Report. (Manhattan Coll., New York). 1962. 62p.

The proposed reactor is a low power, pool type reactor. Design features are summarized and data are presented from core calculations, critical mass calculations, calculations of flux distribution, calculations of temperature and void coefficients, and calculations of fission product activity based on the proposed operation schedule. Control and instrumentation are discussed. Radiation monitoring and safety procedures are outlined. (C.H.)

28601 (ORNL-TM-266) EXPERIMENT FACILITIES OF THE OAK RIDGE GRAPHITE REACTOR. S. D. Sheppard (Oak Ridge National Lab., Tenn.). Aug. 17, 1962. Contract [W-7405-eng-26]. 40p.

Up-to-date descriptive material and dimensional sketches of the ORNL Graphite Reactor and its experimental facilities are presented. (P.C.H.)

28602 (ORNL-TM-281) GENERAL STANDARDS GUIDE FOR EXPERIMENTS IN ORNL RESEARCH REACTORS. C. D. Cagle (Oak Ridge National Lab., Tenn.). Aug. 20, 1962. Contract W-7405-Eng-26. 48p.

The Oak Ridge National Laboratory has three general-purpose research reactors which accommodate testing loops, target irradiations, and beam-type experiments. Since the experiments must share common or similar facilities and utilities, be designed and fabricated by the same groups, and meet the safe safety criteria, certain standards for these have been developed. These standards deal only with those properties from which safety and economy of time and money can be maximized and do not relate to the intent of the experiment or quality of the data obtained. The necessity for, and the limitations of, the standards are discussed; and a compilation of general standards is included. (auth)

28603 (AEC-tr-5180) DESCRIPTION OF THE RACHEL ATOMIC PILE. (Translation). P. Bourgeois, C. Clair, R. Comte, and J. J. Long (France. Commissariat à l'Energie Atomique, Paris). June 1961. Includes Paper: NEUTRON PROPERTIES OF THE RACHEL CRITICAL REACTOR. C. Clair. 16p.

A critical experiment with high-speed neutrons and utilizing Pu metal is described. The information is presented in sections on the pile, core, reflector, mechanisms, containers, instrumentation, and implantation. (J.R.D.)

28604 (TRG-Inf-Ser-17) NEUTRON STUDY OF A PLUTONIUM THERMAL NEUTRON REACTOR "PROSERPINE" — CORRELATIONS BETWEEN NEUTRONS IN A CHAIN REACTION. Jean Tachon (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay).

Translated by J. C. Ruckman (U.K.A.E.A. Reactor Group, Risley, Lancs, Eng.) from report CEA-1547, 1960, 146p.
Thesis submitted to Univ. of Paris.
This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 14025.

28605 MEASUREMENTS OF HORIZONTAL FLUX IN FAST VVR REACTOR AND SAFETY. A. Filip and T. Roşeanu. Acad. rép. populaire Roumaine, Rev. phys., 6: 279-88(1961). (In Rumanian)

Spatial distributions of γ quanta and neutron flux were measured without shielding and with various traps in order to determine the effects of a scatterer on neutron and γ scattering. The scatterer was placed 7 m from the active zone (3.5 m from the reactor wall). Measurements were made for both thermal and fast neutrons. (tr-auth)

28606 DETERMINATION OF ADJOINT THERMAL FLUX IN PERTURBATION EXPERIMENTS. M. Sabău and Th. Roşescu (Inst. for Atomic Physics, Bucharest). Acad. rép. populaire Roumaine, Rev. phys., 6: 305-10(1961). (In English)

The thermal neutron adjoint fluxes in the VVR-S reactor core were determined by the perturbation method using the two-group neutron model. The computed values of the thermal neutron flux and its adjoint for the radial and axial directions are shown graphically. The experimental values of these fluxes are also shown and agree within the limits of error with the computed value. The experimental procedure used to determine the neutron fluxes is briefly described. (J.S.R.)

28607 UTILIZING THE VVR-S REACTOR FOR THE PILE OSCILLATOR METHOD. Al. Ştefănescu and M. Sabău (Inst. for Atomic Physics, Bucharest). Acad. rép. populaire Roumaine, Rev. phys., 6: 311-24(1961). (In English)

The reactor oscillation method with overall variation was used to measure the neutron spectrum in the VVR-S reactor, moderated with natural water. In order to reduce to a minimum the effect of the resonance integral, an oscillating channel was designed, placed within the active core and surrounded by an internal reflector of natural water. The principle of the oscillation method is given and the experimental results on the measurement of the capture cross section, statistical fluctuations of the reactor, and the reactor sensitivity are presented. (J.S.R.)

28608 SHIELDING CALCULATIONS FOR DAPHNE REACTOR. PART II. G. Constantine and K. R. E. Smith (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Chem. & Process Eng., 43: 320-3(July 1962).

The top shield of Daphne consists of a 61-cm-thick layer of barytes concrete. At a reactor power of 0.1 kw (design maximum), the total dose rate behind this shield from fast neutrons, core gamma rays, and capture gamma rays is calculated to be 28 mr/hr. The calculations are carried out for the case in which the fuel elements consist of stacks of parallel plates. If fuel elements composed of plates arranged between concentric cylinders so as to form a hollow annulus are used, the dose rate is over 90 mr/hr. Effects of shield irregularities are taken into account. Shutdown access hazards and the thickness of lead required to shield spent fuel elements for transportation are also considered. (T.F.H.)

28609 THE REACTOR ISPRA-2. S. Barabaschi, U. Farinelli, and R. Zona (Comitato Nazionale Energia Nucleare, Notiz., 8: No. 3, 3-11(Mar. 1962). (RT/ING(62)3). (In Italian)

The swimming-pool-type reactor Ispra-2, which is light-water-moderated, graphite-reflected, and cooled by natural convection, is described. The reactor operates at low power (10 to 100 kw). This reactor became critical the first time on December 15th, 1961, and is installed in the gamma-tank of the Ispra-1 auxiliary facilities. The reactor is to be dismantled in order to be installed in the Nuclear Center of Casaccia. (auth)

28610 CONTROL OF THE TRAINING REACTOR ULYSSE. André Baude (Compagnie des Compteurs, Paris). Inds. atomiques, 6: 81-92(1962). (In French)

The control of the Ulysse reactor, first of the French training reactors, is described. The particular aspects which give to the usual control organs a didactic function are shown. The particular care which has been given to the safety of this reactor is emphasized. (tr-auth)

28611 THE AGN 201 "COSTANZA" REACTOR AND THE PHILOSOPHY OF AUTOMATION. Antonio Sellerio and Maria Concetta Spitale (Universita, Palermo, Italy). Ing. nucleare, 4: 175-81(Sept.-Oct. 1961). (In Italian)

A schematic description of the AGN 201 reactor of the University of Palermo is given with emphasis on the educational advantages offered by a zero power reactor. The philosophy of automation in the design of reactors is illustrated. A brief description of the methods used for the operation of safety and control rods is given. The scram device is illustrated, and the various causes precipitating reactor shutdowns are tabulated. The nuclear fuse used as the ultimate safety device is designed to shutdown the reactor without regard to any other instrument. (J.S.R.)

28612 SIEMENS TRAINING REACTOR SUR AND ITS USE IN NUCLEAR TRAINING COURSES. G. Hildenbrand and P. Hoehne (Siemens-Schuckertwerke A. G., Munich). Kerntechnik, 4: 141-7(Apr. 1962). (In German)

A description is given of the Siemens training reactor SUR, developed for the purpose of nuclear training. It is distinguished by a high degree of inherent safety, its suitability for installation in normal laboratory buildings, and its low operating costs. A training program is prepared which, after an introductory course on radiation measuring methods, in a first course familiarizes the students with the reactor itself and the determination of reactor characteristics. A second course covers neutron-physical experiments and independent work with the reactor. (auth)

28613 RAPID DETERMINATION OF ^{137}Cs IN JRR-1 FUEL SOLUTION BY FOCUSING CHROMATOGRAPHY. Seishi Yajima, Masao Shibuya, and Yoshiyuki Kiso. Nippon Genshiryoku Gakkaishi, 4: 361-5(1962). (In Japanese)

Focusing chromatography was applied to determine Cs^{137} in the burned fuel solution of the reactor JRR-1. Perfect separation of Cs^{137} from the other fission products was possible within 5 to 10 min under suitable conditions, as follows: the fuel solution was diluted to 1/1000 with distilled water; a complexing agent, viz., 0.5 M citric acid or 0.05 M EDTA, was used; the pH gradient of both solutions between anode and cathode was pH 1.5 (HCl)-3.1 (EDTA) or 4.3 (citric acid); the applied voltage was 700 to 900 v/20 cm. After separation, the autoradiographic technique was used to decide the positions of separated lines. The identification and determination of Cs^{137} and the other nuclides were carried out by measuring γ-activity and spectra of their separated lines cut from the strip. The results were used for the determination of the burn-up of JRR-1 fuel. (auth)

28614 MEASUREMENT OF THE LEAKAGE SPECTRUM OF FAST NEUTRONS FROM JRR-1 CORE BY THE NUCLEAR EMULSIONS. Shoji Nomoto and Tomoo Naka-

mura. Nippon Genshiryoku Gakkaishi, 4: 365-73(1962). (In Japanese)

The leakage spectrum of neutrons above 0.5 Mev from the JRR-1 core is measured with nuclear emulsion plates. The plates are exposed to the fast neutron beam extracted from the core through a lead collimator. The hole in which the collimator is situated is a "through tube" and its geometrical condition is rather complicated, so the collimator is made so that only neutrons undergoing single scatterings from its inner surface region can reach the plates. The effect of neutrons scattered inelastically on the collimator is numerically estimated and found to be negligible. Neutron energies are deduced by measuring the length of protons that recoil in a small angle with respect to the incident beam direction. The method of plate analysis is described. (auth)

28615 THE McMASTER NUCLEAR REACTOR. W. H. Fleming (McMaster Univ., Hamilton, Ont.). Research Reactor J., 2: No. 4, 1-10(July 1962).

The reactor is a 1-Mw, graphite-reflected, light-water swimming pool reactor, fueled with MTR-type fuel elements to a nominal fuel loading of 196 g of U^{235}. Typical core configurations are discussed. The research facilities and programs are described, as well as the operating history, staff, costs, and problems. (T.F.H.)

28616 THERMODYNAMIC INVESTIGATIONS OF THE AVR REACTOR. J. Binckebanck and H. Ottl. Tech. Mitt. Krupp, 20: 115-18(Apr. 1962). (In German)

Experimental investigations were made on the heat transfer and pressure drop in a gas stream flowing through a ball pile and through tube bundles in crosswise arrangement. A theoretical estimation of the heat conductivity of the ball pile was made with special consideration of the natural convection current at higher gas pressures. The effect of the temperature-dependent material values on the heat transfer at high temperature gradients in the coolant flow boundry layer was determined. (tr-auth)

28617 IMPROVEMENTS IN NEUTRON REACTORS. Lyle B. Borst and Paul A. Michael (to Dow Chemical Co.). British Patent 900,055. July 4, 1962.

Modifications are discussed for the Convergatron, a polarized multistage neutron amplifier described in British Patent 850,876. The modifications are to increase the ratio of output neutrons to input neutrons while depressing increase of the multiplication factor of the reactor stage, thus increasing the transparency of the reactor. Some of the modifications comprise concentrated fuel layers, oriented cavities, and moderator modifications. (D.L.C.)

28618 APPARATUS FOR PRODUCTION OF RADIOACTIVE ISOTOPES. Walter H. Zinn (to Curtiss-Wright Corp.). U. S. Patent 3,049,484. Aug. 14, 1962.

A reactor unit is designed for producing radioisotopes by reactor irradiation of an absorber, particularly cobalt. The unit comprises spaced side walls, fuel plates secured to the side walls with spaces for coolant passage, and absorber plates interposed between the fuel plates. A plurality of such units is inserted into a reactor vessel to form a critical assembly; because of the absorber material, more U^{235} can be used than can be used safely in conventional power reactors. The absorber material may be removed from the unit by mechanical destruction. (D.L.C.)

SPACE APPLICATIONS AND TECHNOLOGY

28619 (NP-11863) NUCLEAR PROPULSION TESTING TECHNIQUES. Paul E. Brown (Radio Corp. of America, Aerospace Communications and Controls Div., Camden, N. J.). 1962. 90p.

Studies are being made to satisfy the test requirements of nuclear rockets, with application also to the nuclear ramjet and auxiliary power systems. The basic features of the nuclear rocket engine are described. Current programs in nuclear power for aerospace applications are discussed. Design and support problems and testing considerations for this type of system are outlined. Techniques for testing are described. (M.C.G.)

28620 (NP-11924) R-F BLACKOUT PHENOMENA: AN ANNOTATED BIBLIOGRAPHY. George R. Evans, comp. (Lockheed Missiles and Space Co., Sunnyvale, Calif.). Apr. 1962. Contract AF 04(647)-787. 84p. (SB-62-18)

When a space vehicle or missile re-enters the earth's atmosphere, the ionization of the air around the re-entry body in the presence of applied magnetic fields creates an R-F blackout. This situation prevents communication between the space vehicle and ground stations, and increases the difficulty of radar identification of a re-entry body. The references cited contain information on the theoretical and experimental studies of the causes of the R-F blackout phenomenon and possible solutions to the problem. The period covered is 1959 to February 1962. (auth)

28621 (R62SD35) END LOSSES IN MAGNETOHYDRODYNAMIC CHANNELS WITH TENSOR ELECTRICAL CONDUCTIVITY AND SEGMENTED ELECTRODES. George W. Sutton (General Electric Co. Missile and Space Vehicle Dept., Philadelphia). Mar. 1962. Contract AF 49(638)-914. 60p.

End losses of an inviscid magnetohydrodynamic channel having tensor conductivity and segmented electrodes were calculated for a magnetohydrodynamic power generator of this geometry. It was found that the constant-current configuration is more efficient than the constant potential difference case. The efficiencies increased with increasing Hall effect, but constant magnitude extensions to the magnetic field had very little effect. The theoretical efficiency for an aspect ratio of 10 and $\omega\tau = 2$ was 74%. (auth)

28622 ESTIMATION OF IRRADIATION OF SPACECRAFT COMPONENTRY BY SCATTERED NEUTRONS. Donald W. Grunditz (Avco Corp., Wilmington, Mass.). ARS (Am. Rocket Soc.) J., 32: 1090(July 1962).

A spacecraft is considered that uses a reactor, which is shielded from the radiation-sensitive components on the vehicle but is not shielded from other parts of the vehicle. The neutron flux at the radiation-sensitive components arising from neutron scattering from the unshielded parts of the craft is estimated, assuming the scatterer to be a material having a scattering and absorption cross section on the order of a few barns (e.g., Al or Fe). Assuming a total path length for the scattered neutron of about 20 ft, the integral flux for an irradiation time of 10^4 hr may be on the order of 10^{14} neutrons/cm^2. (T.F.H.)

28623 ELECTRIC POTENTIAL IN A BEAM NEUTRALIZED BY NEGATIVE IONS. S. W. Kash (Illinois Inst. of Tech., Chicago). ARS (Am. Rocket Soc.) J., 32: 1103-4(July 1962).

The electric potential in a broad positive ion beam neutralized by negative atomic ions is calculated, taking into account the mass of the negative ions and assuming no positive-negative collisions. The spatial period, that is, the distance over which the motion and potential repeat, is found to depend on the amplitude of the potential variations. The electric field and thrust of this type of beam are calculated. It is found that for given electric current (of one charge species) and energy flux density, the thrust is at a maximum when the positive and negative ion velocities are equal at the exit plane of the ion motor and when the electric field just outside the exit plane is zero. (T.F.H.)

28624 MAGNETOHYDRODYNAMIC GENERATORS AND NUCLEAR PROPULSION. R. J. Rosa (Avco-Everett Research Lab., Everett, Mass.). ARS (Am. Rocket Soc.) J., 32: 1221-30(Aug. 1962).

Some of the more advanced possibilities for using the potential high temperature and high specific power capability of the magnetohydrodynamic generator in nuclear propulsion are discussed. Radiating and nonradiating closed cycles using liquid and gas core reactors are considered. Also considered is a thrust-augmenting scheme that might substantially enhance the performance of any type of high-thrust propulsion system. (auth)

28625 REVOLVING BELT SPACE RADIATOR. H. L. Burge (Rocketdyne Div., Canoga Park, Calif.). ARS (Am. Rocket Soc.) J., 32: 1243-8(Aug. 1962).

A significant proportion of the total weight in a large spaceborne electrical power plant is associated with the radiator. The belt space radiator offers a concept in the rejection of heat in a space environment that may theoretically reduce the radiator weight by more than 60% if thermal contact resistance between the revolving belt and heat source drum is sufficiently small. A theoretical analysis of the effects of contact resistance on optimum weight applicable to a revolving belt radiator with a stationary condenser drum, as well as to a system with revolving condenser drum and geometrically stationary belt configuration for a 1-megawatt power output system, is given. It is found that the effective contact heat transfer film coefficient must be approximately 400 Btu/hr-ft^2-°F to realize significant weight savings. If this value of film coefficient can be obtained, the belt radiator must be considered as a replacement for conventional header and tube radiators for spaceborne power plants. (auth)

28626 THERMIONIC CONVERTERS IN A LARGE NUCLEAR ELECTRIC POWERPLANT IN SPACE. Daniel T. Bernatowicz (NASA Lewis Research Center, Cleveland). ARS (Am. Rocket Soc.) J., 32: 1256-61(Aug. 1962).

A parametric analysis of thermionic converter systems for large space powerplants is presented, and the thermionic systems are compared to the Rankine-cycle turbogenerator on the basis of radiator area per unit of output power. Thermionic performance is computed with the height of the potential barrier above the Fermi levels in the cathode and anode as parameters. The minimum possible radiator area is determined for several configurations as a function of cathode and radiator temperatures. In comparing the thermionic and turbogenerator systems, it is assumed that radiator area is a physically significant index of the powerplant mass, that corrosion limits the liquid metal temperature, and that this limit is the same in both systems. If the liquid metal is used to heat the cathodes, the thermionic system is restricted to peak tem-

peratures the same as those for a turbogenerator, and the thermionic system requires a larger radiator. Incorporating the thermionic diodes into a reactor fuel element and using a liquid metal to cool the anodes allows them to operate at a higher peak temperature for the same corrosion limit. This scheme permits substantial savings in radiator area, up to 50% at a cathode temperature of 1700°K and up to 80% at 2300°K. (auth)

28627 NUCLEAR ENERGY FOR THE PROPULSION FOR SPACE VEHICLES. Eberhard Rees (George C. Marshall Space Flight Center, Huntsville, Ala.). Atomwirtschaft, 7: 256-60(May 1962). (In German)

The theoretical possibilities of various nuclear propulsion systems are evaluated in terms of their specific impulse. The specific disadvantages of nuclear propulsion are high weight-to-thrust ratio, presence of radiation, and high operating temperature. Special applications of first generation nuclear rockets are discussed, and the possible applications of later generations are reviewed. The development of electrical drives is directed toward three systems: electrostatic or ion drives with small nuclear reactors as power source; electrothermal or plasma drives using a nuclear reactor as a power source for the heating of gases in an arc; and electromagnetic or magnetodynamic drives. (J.S.R.)

28628 RITA—THE REUSABLE INTERPLANETARY TRANSPORT APPROACH TO SPACE TRAVEL. Raymon W. Hallet, Jr., Willard E. Matheson, and Robert F. Trapp (Douglas Aircraft Co., Santa Monica, Calif.). ARS No. 2042-61 presented at American Rocket Society Space Flight Report to the Nation, October 1961, New York. Engineering Paper No. 1198. New York, American Rocket Society, [1961].

A development program for achieving economy of operation, flight-schedule convenience, ease of maintenance, and versatility of utilization is presented; development of a space transportation system is discussed. Conventional system capabilities are reviewed in terms of mission requirements and economy of operation; vehicles are described; and performance, recovery, and nuclear safety are discussed. (L.N.N.)

28629 ADVANCES IN ASTRONAUTICAL PROPULSION. PROCEEDINGS OF A SEMINAR HELD IN MILAN, 8-12 SEPTEMBER, 1960. Corrado Casci, ed. International Series of Monographs in Aeronautics and Astronautics. Division IX: Symposia. Volume 11. London, Pergamon Press, 1962. 386p.

Fourteen papers are included; separate abstracts have been prepared for four. The remaining ten papers cover such subjects as general space propulsion problems, the mechanics of space propulsion, solid- and liquid-propellant propulsion and propulsion systems, reentry, propulsion and guidance requirements for aero-space flights, and the exploration and utilization of space. (T.F.H.)

28630 NUCLEAR ROCKETS FOR SPACE FLIGHT. Eugen Saenger (Forschungs Institut fur Physik der Strahlantriebe, Stuttgart). p.147-64 of "Advances in Astronautical Propulsion." London, Pergamon Press, 1962.

Rocket performance, the increase in energy, the annihilation of mass, the exhaust velocity, etc. are reviewed. The basic equations of non-adiabatic systems of photonic rockets are considered. These systems are compared with liquid- and solid-propellant rockets. The application of nuclear fission reaction to rocket propulsion is studied. After a discussion of these pure fission rockets, the advantages of photonic fission rockets are described and convective fission rockets, water plasma fission rockets, electrostatic ionic rockets, and electromagnetic plasma rockets are summarized. The question of nuclear fusion rockets and their application to adiabatic rockets is also reviewed. The annihilation radiation of matter is discussed. (auth)

28631 NUCLEAR FISSION ROCKETS: PROBLEMS, PROGRESS AND PROMISE. Robert W. Bussard (Los Alamos Scientific Lab., N. Mex.). p.165-220 of "Advances in Astronautical Propulsion." London, Pergamon Press, 1962.

Two central problems make difficult the development of rocket reactors. First is the necessity of achieving high gas temperature; values comparable with chemical rocket combustion temperatures are desired. Second is the necessity of achieving large power output from a heat exchanger system of small mass; for vehicle acceleration of one earth-gravity, reactor specific power of the order of one thermal megawatt per kilogram of reactor mass is desired. On the basis of strength and melting point data, estimates can be made of the maximum usable temperature for various fuel element materials. Results of such estimates are given together with approximate values for specific impulse attainable from H_2 and dissociated NH_2 heated propellants for operation between 10 and 100 atm. Study of the relations between reactor neutronics, geometry, mass, and heat exchanger design leads to the conclusion that fast reactors are most useful in sizes below about 500 megawatts thermal power and 10,000 kilodynes (about 22,000 pounds) thrust; and that reactors with thermal or intermediate neutron spectra, using low density neutron-moderating fuel structures, yield better performance as the power and thrust are made larger. For propellant performance beyond the levels above it is necessary to consider liquid and gaseous nuclear-fueled heat exchangers, and electrical propulsion systems. Nuclear-electric propellant-accelerator systems offer promise of specific impulse values up to perhaps 12,000 seconds, but only at the price of very low vehicle acceleration. Typically, a force-acceleration of about $\frac{1}{2}$ cm/sec^2 is the best that can be done with an electric power plant of conventional type, for a propellant specific impulse of 3000 seconds. This results principally from the massiveness of the rotating machinery required, but even if direct conversion of fission to electrical energy is accomplished (e.g. by plasma-filled thermionic diodes), it is unlikely that an improvement of more than a factor of 5 will result. Reactors in which the fissionable fuel as well as the propellant are in the gaseous state are capable in principle of reaching temperatures of the order of 40,000°C; for practical operation however, these require that unfissioned fuel atoms be retained in the gaseous core while allowing the heated propellant to escape. Study of reactors leads to the conclusion that collision-diffusion losses across magnetic fields used for containment, and Helmholtz instabilities in shear flows, limit reactor power output to such an extent that vehicle accelerations can never be greater than the order of one cm/sec^2 with propellant specific impulse of 2000 to 5000 seconds. Centrifugally stabilized liquid-fuel reactors appear free from these difficulties but have problems of startup and control. At best, liquid fuels might provide another 1000°C above the limit temperatures of the best solids. (auth)

28632 MAGNETO-FLUID DYNAMICS PROBLEMS RELATED TO SPACE PROPULSION. Manlio Abele (Polytechnic Inst. of Brooklyn, Freeport, N. Y.). p.221-33 of "Advances in Astronautical Propulsion." London, Pergamon Press, 1962.

The basic processes governing the motion of a plasma under the influence of an electromagnetic field are outlined.

The acceleration in a distribution of crossed electric and magnetic fields is discussed. The research devoted to the possible schemes of acceleration is summarized. Some of the geometries that might be applied for propulsion purposes are reviewed. The problems related to the losses of energy from the plasma to the walls of the container and to the instabilities resulting from undesirable oscillations of the plasma itself are outlined. A particular problem of excitation of plasma waves as a result of the displacement of an electromagnetic perturbation is discussed. (auth)

20633 ELECTRIC POWER GENERATION IN SPACE BY SOLAR AND OTHER MEANS. Albert E. von Doenhoff (National Advisory Space Administration, Washington, D. C.). p.237-58 of "Advances in Astronautical Propulsion." London, Pergamon Press, 1962.

Electric power generation in space is discussed. The means considered include chemical and nuclear as well as solar sources. Basic characteristics of each type are described, including an indication of the practical operational difficulties associated with each type of source. Means for converting heat and photon energy to electrical energy are described. These include mechanical systems using thermo-dynamic working fluids, thermoelectric devices, thermionic devices and photovoltaic devices. The characteristics and probable roles of each type are discussed. Some space power projects are described, including the solar power system for the Ranger series of spacecraft for lunar missions, the 3-kw Sunflower I solar power system and the SNAP VIII 30-kw nuclear power system. (auth)

WASTE DISPOSAL AND PROCESSING

28634 (CRER-1089) MOVEMENT OF RADIOACTIVE WASTE THROUGH SOIL. 5. THE LIQUID DISPOSAL AREA. P. J. Parsons (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1962. 19p. (AECL-1561)

Two seepage pits, used for the routine disposal of water containing low-level radioactive wastes, were examined by a soil and groundwater survey. Reactor Pit 2 received 1.75×10^8 gallons and absorbed 11000 curies of soluble β-emitting radionuclides with 90 g Pu. Of these, 87 curies migrated as cations and the weak front of this movement, containing Sr^{90}, Co^{60}, Cs^{137}, and Ce^{144}, is expected to be released into the runoff of a nearby swamp in 4 years. The Chemical Pit, used for the disposal of low-level moderately acid waste accumulated 500°C of total β and 50 g Pu. It recently released Sr^{90} and Co^{60} into a nearby swamp three months after receiving a disposal containing high concentrations of complexing agents. Soil and groundwater sampling showed that the ion-exchange capacity of the soil was greatly reduced and that the escape of Co^{60} will increase to roughly three times its present value. The escape of Sr^{90} is not expected to increase. (auth)

28635 (DLCS-2180102) PERIODIC CHARACTERIZATION OF RADIOACTIVE WASTE DISPOSAL EFFLUENTS. CORE I SEED 3. Test Evaluation. (Duquese Light Co., Shippingport, Penna.). First issue, June 13, 1962. Contract [AT(11-1)-292]. 25p.

Data are given on the radioactive nuclides present in waste disposal effluents during Nov. 1961. The concentrations of all activities was well within established limits for discharge to the environment. (C.H.)

28636 (ORNL-TM-282) THE DISPOSAL OF RADIOACTIVE LIQUID AND GASEOUS WASTE AT OAK RIDGE NATIONAL LABORATORY. J. F. Manneschmidt and E. J. Witkowski (Oak Ridge National Lab., Tenn.). Aug. 17, 1962. Contract W-7405-eng-26. 5p.

Radioactive waste disposal facilities, monitoring procedures, and control operations at ORNL are reviewed. The wide variety of activities results in large volumes of radioactive liquid or gaseous wastes that may contain hazardous quantities of a wide variety of radionuclides. Wastes are classified according to their activity. A cell ventilation system and an off-gas system consisting of stacks, filters, and electrostatic precipitators remove radioactivity from gases. Low-level liquid wastes are treated chemically to remove the greater part of the radioactivity prior to discharge into a stream and river system. Dilution in the river then reduces the concentration of radioactivity levels well below maximum permissible concentrations. Intermediate-level liquid wastes are discharged into the soil where the radioactivity is separated and retained by sorption. The partially decontaminated seepage eventually reaches the river. A water treatment plant is operated for the decontamination of process-waste water. Only very small quantities of high-level wastes are generated and these are usually permanently stored. The disposal of these wastes is not discussed. Monitoring systems and equipment are described and illustrated. (C.H.)

28637 (AEC-tr-5079) TREATMENT OF RADIOACTIVE WASTE WITH ION EXCHANGE MEMBRANE ELECTRODIALYZER. Masukuni Ito and Mutsumi Nishidoi (Japan Atomic Energy Research Inst., Tokyo). Translated from report JAERI-1012. 1960. 24p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 4796.

28638 RADIOACTIVE WASTE FROM NUCLEAR POWER STATION. Tatsuo Kimura. Nippon Genshiryoku Gakkaishi, 4: 398-410(1962). (In Japanese)

The nature and amount of radioactive wastes resulting from the operation of nuclear power stations depend on the type of the reactor. As the difference can be attributed mainly to the reactor coolant properties, a description is given of the origins of radioactive contamination of reactor coolants, and a review is presented of the properties and disposal of radioactive wastes from various types of reactors, viz., pressurized-water, boiling water, organic moderated, gas-cooled, and sodium-cooled reactors. (auth)

28639 PROCESSING LIQUID LABORATORY WASTE CONTAINING RADIOACTIVE ISOTOPES. V. V. Vol'khin, A. K. Shtol'ts, and E. M. Dosik. Radiokhimiya, 4: 220-6 (1962). (In Russian)

Effects of the solidifying process on the volume of calcium phosphate precipitates were studied, and suitable conditions for purifying radioactive supernatant by phosphate coagulation combined with solidification were found. Ca^{45}, Zn^{65}, Sr^{89}, Sr^{90}, Y^{90}, Y^{91}, and Ce^{144} sorbed on calcium phosphate were not desorbed after solidification. An additional reduction in volume (up to 30%) was observed after precipitate dehydration. The precipitate volume was reduced by a factor of 10 following phosphate supernatant coagulation. (R.V.J.)

28640 GLACIOLOGICAL INTRODUCTION TO THE PROBLEMS OF DISCARDING RADIOACTIVE WASTES IN THE GREAT ICE CAPS OF EARTH. R. Haefeli. Schweiz. Z. Hydrol., 23: 253-62(1961).

Calculations of the rheological behavior of Greenland icebergs, by considering ice as non-Neutonian fluid, revealed that the time of ice movement (10,000 to 30,000 years) is much greater than half lives of radioactive wastes. Therefore, it is concluded that waste disposal in arctic or antarctic glaciers is an ideal solution to the problem. (P.C.H.)

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æ	becomes	ae
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A-AC–	**(Misc.)**	
82/G/L.763	16-26726	J. Radiation Research (Japan) 3: No. 1, (1962)
82/G/L.764	16-26727	J. Radiation Research (Japan) 3: No. 1, (1962)
ABCC-TR–		
24-60	16-26673	Am. Rev. Respirat. Diseases 84: No. 2, 256-62(1961)
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270136*	16-28251	OTS
270678*	16-27189	OTS
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1543	16-27055	Can. J. Chem. 40: 1616-25(1962)
1544	16-27598	See CRFD-1094
1555	16-27600	See CW-R&DL-24
1560	16-26966	Dep.; $0.50(AECL)
1561	16-28634	See CRER-1089
1563	16-27599	See CRFD-1100
AEEW-R–	**(British)**	
102	16-28010	Dep.; $0.84(BIS)
AERE-M–	**(British)**	
991	16-27716	Phil. Mag. (8), 7: 1061-4(1962)
AERE-Memo–	**(British)**	
G/M-117	16-28172	Dep.(mc)
AERE-R–	**(British)**	
3363	16-26806	J. Dairy Research 29: No. 1, 1-10(1962)
3818	16-26890	Dep.; $1.68(BIS)
3827	16-27502	Intern. J. Air & Water Pollution 6: 121-8 (1962)
3976	16-27157	Dep.; $0.70(BIS)
4018	16-27417	Dep.; $0.21(BIS)
4027	16-26952	Dep.; $1.12(BIS)
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889	16-27639	Dep.
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62-29	16-26868	
AFOSR–	**(Misc.)**	
2254*	16-28023	
2590*	16-27859	See CRSR-119
3018*	16-28252	
AFOSR-TN–	**(Misc.)**	
61-394	16-27794	J. Research Natl. Bur. Standards, 66C: 51-8(1962)
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59-84	16-27190	
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19	16-27248	Dep.; $2.24(BIS)
Al-Memo–		
6416	16-27586	Dep.(mc); $1.60(fs), $0.80(mf) OTS
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61-152	16-27156	See AD-269792
62-105	16-27418	See NP-11961
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6299	16-28595	Dep.; $2.00(OTS)
6539	16-28357	Dep.; $2.50(OTS)
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305(Suppl.1)	16-28521	Dep.(mc); $4.60(fs), $1.52(mf) OTS
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1193-12	16-28024	Dep.(mc); $5.60(fs), $1.79(mf) OTS
2220-15*	16-27623	
2227-6*	16-27587	
4226-1	16-28526	Dep.; $4.00(OTS)
ARL–	**(Non-AEC)**	
62-334	16-28253	OTS
62-336	16-26953	$2.00(OTS)
AROD–	**(Misc.)**	
2504:2*	16-27249	
ASD-TDR–	**(Non-AEC)**	
62-12	16-27692	OTS
62-203(Pt.1)	16-27588	OTS
62-314	16-27624	OTS
ASD-TR–	**(Non-AEC)**	
7-882(VII)	16-27596	
7-996(V)	16-27623	See ARF-2220-15
62-7-644	16-27605	See NOR-62-25
AWRE-Trans–	**(British)**	
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1107	16-28359	Dep.(mc); $11.00(fs), $4.52(mf) OTS
BCH-MOO–	**(Belgian)**	
5	16-27471	For translation see EURAEC-196
BLG–	**(Belgian)**	
78	16-27090	Nucl. Med., 2: 61-6(1961)
BM-IC–	**(Non-AEC)**	
8082	16-27625	Free(Bureau of Mines)
BM-RI–	**(Misc.)**	
5990*	16-27589	Free(Bureau of Mines)

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6025*	16-27597	Free(Bureau of Mines)
6029*	16-26954	Free(Bureau of Mines)
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293	16-28252	See AFOSR-3018
BNL–		
4794	16-27345	Trans. N. Y. Acad. Sci. 23: 357-74(1961)
4860	16-26804	J. Comp. Neurol. 115: 219-41(1960)
4861	16-26805	J. Comp. Neurol. 115: 243-95(1960)
5197	16-26841	Yokohama Igaku 12: No. 1, 4-22(1961)
5252	16-28313	Eng. News-Record 167: 50-1(1961)
5657	16-26851	p.183-219 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962
5805	16-26710	Radiation Research 17: 173-85(1962)
5806	16-26845	p.17-46 of "Effects of Ionizing Radiations on Immune Processes." New York, Gordon and Breach Science Publishers, 1962
5899	16-26682	Radiation Botany 1: 255-68(1962)
5952	16-28138	Phys. Rev. 127: 224-30(1962)
6022	16-28142	Phys. Rev. 127: 524-8(1962)
6023	16-28141	Phys. Rev. 127: 517-23(1962)
CE–		
1077	16-28563	See TID-16381
CEA–	**(French)**	
1664	16-27685	p.512-24 of "Proceedings of the Fourth International Symposium on the Reactivity of Solids." Amsterdam, Elsevier Publishing Company, 1960.
1954	16-27792	J. phys. radium, 22: 764-9(1961)
2001	16-27572	Vide, No. 95: 207-28(1961)
2025	16-28062	J. phys. radium, 22: 204-14(1961)
2090	16-26909	Anal. Chem., No. 10, 462-4(1961)
2096	16-27452	Houille blanche, 599-611(1960)
2121	16-28254	Dep.(mc)
2122	16-27191	Dep.(mc)
2127	16-27032	Dep.(mc)
2145	16-27110	Chim. and Ind. (Paris), 86: 29-38(1961)
2150	16-26708	Prods. pharm., 17: 1-16(1962)
2151	16-27706	Bull. soc. franc. minerol. et crist., 84: 353-63(1961)
CEA-tr–	**(French)**	
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118	16-27858	
119	16-27859	
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EIR–	**(Swiss)**	
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EURAEC–		
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316	16-27198	See UNC-5009
350	16-27558	See BMI-X-195
FTD-TT–	**(Non-AEC)**	
62-12	16-27746	OTS
62-42	16-27472	OTS
62-273	16-27608	OTS
62-333	16-27202	OTS
62-378	16-27917	OTS
62-430	16-27640	OTS
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2437	16-28017	Nuclear Sci. and Eng. 13: 306-24(1962)
2510	16-28011	Dep.(mc); $2.60(fs), $1.10(mf) OTS
2946	16-28274	Phys. Fluids 5: 776-88(1962)
3060	16-28394	See TID-7631(p.104-15)
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100	16-27348	In Proceedings of 5th International Instruments and Measurements Conference, Sept. 13/16, 1961, N. Y., Academic Press, 1961
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65836	16-28596	Dep.(mc); $1.10(fs), $0.80(mf) OTS
69027	16-27120	Dep.; $0.75(OTS)
72322	16-27693	Dep.(mc); $1.60(fs), $0.80(mf) OTS
72616	16-27546	Dep.(mc); $2.60(fs), $0.98(mf) OTS
73030	16-28533	$9.60(fs), $3.80(mf) OTS
73116	16-27726	Dep.; $2.50(OTS)
73335	16-27254	Dep.; $1.75(OTS)
73395	16-27192	Dep.(mc); $1.60(fs), $0.80(mf) OTS
73654	16-27463	Dep.(mc); $1.10(fs), $0.80(mf) OTS
74194	16-27160	Dep.(mc); $1.10(fs), $0.80(mf) OTS
HW-SA–		
1947	16-27168	Electronics, 33: No. 49, 74: 76(1960)
1989	16-26714	Trans. Am. Nuclear Soc. 3: 536-7(1960)
2058	16-28534	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2283	16-27296	Nuclear Instr. & Methods 15: 243-8(1962)
2454	16-27592	Dep.(mc); $1.60(fs), $0.83(mf) OTS
2464	16-28404	See TID-7631(p.256-69)
2522	16-27731	See HW-73116(p.37-50)
2569	16-27121	Dep.(mc); $5.60(fs), $1.82(mf) OTS
2622	16-27897	$1.60(fs), $0.80(mf) OTS
HW-tr–		
41	16-26721	Dep.(mc); $1.10(fs), $0.80(mf) JCL
IA–	**(Non-AEC)**	
689	16-28597	Dep.(mc)
IDO–		
12020	16-27464	Dep.; $1.00(OTS)
16699(Rev.)	16-28026	Dep.; $2.00(OTS)
16749	16-28012	Dep.; $1.00(OTS)
16755	16-28365	Dep.; $5.00(OTS)
IG-Inf. Ser.–	**(British)**	
9	16-27164	Dep.
IS–		
159	16-27612	Proc. Iowa Acad. Sci. 68: 202-21(1961)
303	16-27788	IBM J. research develop. 6: 82-3(1962)
307	16-26985	Discussions Faraday Soc. 32: 79-83(1962)
398	16-27816	Phys. Rev. 127: 72-6(1962)
JAERI–	**(Japanese)**	
1033	16-26956	
JINR–	**(Russian)**	
D-958	16-27900	Dep.(mc)
D-988	16-28027	Dep.(mc)
E-918	16-28028	Dep.(mc)
E-945	16-27901	Dep.(mc)
E-952	16-28029	Dep.(mc)
E-961	16-27902	Dep.(mc)
E-994	16-27903	Dep.(mc)
E-998	16-27904	Dep.(mc)
P-871	16-27905	Dep.(mc)
P-895	16-27255	Dep.(mc)
P-996	16-28030	Dep.(mc)
JLI–		
650-8-8	16-26643	Dep.; $3.00(OTS)
JPRS–	**(Non-AEC)**	
13505	16-27860	OTS
13555	16-26666	OTS
13752	16-28233	OTS
13919	16-26690	OTS
13977	16-27567	OTS
14370	16-27918	OTS
14449	16-27473	OTS
14515	16-27747	OTS
14762	16-26743	OTS
14767	16-26668	OTS
KAPL-M–		
GLB-8	16-27547	Dep.(mc); $2.60(fs), $0.89(mf) OTS
PPA-40	16-28535	$5.60(fs), $1.97(mf) OTS
KFK-tr–	**(German)**	
103	16-27130	Dep.(mc); $1.60(fs), $0.80(mf) JCL
104	16-26968	Dep.(mc); $1.60(fs), $0.80(mf) JCL
KR–	**(Norwegian)**	
23	16-27256	Dep.(mc)
LA–		
2679	16-27257	Dep.; $0.50(OTS)
2691	16-27258	Dep.; $0.50(OTS)
2714	16-28031	Dep.; $1.75(OTS)
LAMS–		
2716	16-27601	Dep.; $3.60(fs), $1.13(mf) OTS
2720	16-28536	Dep.; $0.50(OTS)
M–	**(Misc.)**	
298	16-28231	See TID-16083
MAB–	**(Non-AEC)**	
139-M(C3)	16-27602	
181-M	16-27603	
MATT–		
112	16-28280	Phys. Fluids 5: 864-5(1962)
116	16-28279	Phys. Fluids 5: 815-16(1962)
ME–	**(Misc.)**	
5-62-TN-2	16-27163	See TID-16358
MEWD–	**(Non-AEC)**	
1129	16-27741	See NP-11716
MITNE–		
16	16-28367	See NYO-10204
MLM–		
1132TR	16-27537	Dep.; $0.50(OTS)
MND-M–	**(Misc.)**	
1817	16-28537	Dep.(mc); $19.75(fs), $9.43(mf) OTS
MND-P–		
2726	16-27548	Dep.; $2.75(OTS)
2761	16-27740	Dep.(mc); $5.60(fs), $1.73(mf) OTS
MPR-XIII–		
5-62	16-27193	See TID-15969
6-62	16-27194	See TID-16217
NAA-SR–		
6504	16-27626	Dep.; $2.00(OTS)
6801	16-28538	Dep.; $0.50(OTS)
7368	16-28598	Dep.; $0.75(OTS)
NAA-SR-Memo–		
7253	16-28366	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7294	16-28539	Dep.(mc); $4.60(fs), $1.67(mf) OTS
NASA-TN–	**(Misc.)**	
D-1343*	16-27906	$1.00(OTS)
D-1403*	16-26957	$0.75(OTS)
NM–	**(Misc.)**	
111*	16-28599	See NP-11630
NMI–	**(Misc.)**	
2602	16-27604	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9243*	16-27627	
9519*	16-27628	
NOR–	**(Non-AEC)**	
62-25	16-27605	
NP–	**(AEC File No. for Non-AEC Reports)**	
11630	16-28599	Dep.(mc); $16.50(fs), $7.79(mf) OTS
11631	16-28032	
11633	16-27907	Dep.(mc)

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11634	16-27908	Dep.(mc)
11716	16-27741	
11733	16-28013	Dep.(mc)
11736	16-26958	
11755	16-26644	
11775	16-27909	Dep.(mc)
11787	16-28255	
11792	16-27259	
11833	16-28033	Dep.(mc)
11839	16-27910	
11847	16-26734	
11862	16-28540	
11863	16-28619	
11864	16-27260	Dep.(mc)
11885	16-28600	Dep.(mc); $6.60(fs), $2.06(mf) OTS
11897	16-26959	
11902	16-28316	Dep.(mc)
11911	16-26645	Dep.(mc)
11924	16-28620	OTS
11925	16-27033	
11928	16-27465	
11941	16-27466	Dep.(mc)
11961	16-27418	
11963	16-27559	
11964	16-27560	
11966	16-26655	
11969	16-27629	
11983	16-27742	
NP-tr-	**(AEC File No. for Non-AEC Translations)**	
891	16-27165	Dep.(mc); $2.60(fs), $0.95(mf) JCL
897	16-26969	Dep.(mc); $1.60(fs), $0.80(mf) JCL
906	16-27271	Dep.(mc); $1.60(fs), $0.80(mf) JCL
914	16-26970	$2.60(fs), $1.10(mf) JCL
NRL-	**(Misc.)**	
5792*	16-27261	
NUMEC-P-		
41	16-27561	Dep.(mc); $1.10(fs), $0.80(mf) OTS
42	16-27630	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NYO-		
2668	16-26646	Dep.(mc); $12.00(fs), $5.21(mf) OTS
2760	16-26735	Dep.(mc); $14.00(fs), $6.50(mf) OTS
9174	16-27122	Dep.(mc); $3.60(fs), $1.28(mf) OTS
9391	16-27079	See RRL-55
9431	16-27631	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9700	16-27743	Dep.(mc); $9.10(fs), $3.47(mf) OTS
9701	16-27744	Dep.(mc); $3.60(fs), $1.25(mf) OTS
9810	16-27161	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9864	16-27034	Dep.; $1.00(OTS)
9949(Pt.II)	16-28527	See CEND-150(Pt.II)
10035	16-27993	Phys. Rev. 127: 251-3(1962)
10036	16-27911	Dep.(mc); $3.60(fs), $1.28(mf) OTS
10058	16-26901	Dep.(mc); $2.60(fs), $0.86(mf) OTS
10086	16-27262	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10200	16-27035	Dep.(mc); $2.60(fs), $0.98(mf) OTS
10204	16-28367	Dep.; $2.75(OTS)
10232	16-27912	Dep.(mc); $5.60(fs), $1.91(mf) OTS
10235	16-27913	Dep.(mc); $2.60(fs), $0.89(mf) OTS
ORNL-		
1169	16-27534	Dep.(mc); $4.60(fs), $1.58(mf) OTS
1956	16-26960	Dep.(mc); $3.60(fs), $1.13(mf) OTS
2278	16-26961	Dep.(mc); $4.60(fs), $1.64(mf) OTS
2703	16-28541	Dep.(mc); $8.10(fs), $2.90(mf) OTS
3301	16-27535	Dep.; $2.00(OTS)
3302	16-28368	Dep.; $4.50(OTS)
ORNL-TM-		
80	16-27143	Nuclear Sci. and Eng. 13: 391-7(1962)
187	16-27123	Dep.(mc); $2.60(fs), $0.98(mf) OTS
236	16-28014	Dep.; $18.00(fs), $8.69(mf) OTS
257	16-27124	Dep.(mc); $2.60(fs), $1.04(mf) OTS
266	16-28601	Dep.(mc); $3.60(fs), $1.40(mf) OTS
281	16-28602	Dep.(mc); $4.60(fs), $1.64(mf) OTS

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282	16-28636	Dep.(mc); $5.60(fs), $1.73(mf) OTS
299	16-27694	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORO-		
485	16-26900	Dep.; $0.50(OTS)
OTS-	**(Misc.)**	
61-31210*	16-27131	$1.50(OTS)
PAN-	**(Polish)**	
282/XVI	16-26962	Dep.
292/VI	16-27868	Dep.
299/I-A	16-28175	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
899,516	16-27171	
900,015	16-28449	
900,016	16-28588	
900,055	16-28617	
900,056	16-28589	
900,076	16-28450	
900,078	16-28451	
900,102	16-27383	
900,113	16-27149	
900,157	16-27150	
900,235	16-28452	
900,247	16-27172	
900,288	16-28309	
900,308	16-28453	
900,344	16-28310	
900,347	16-28454	
900,348	16-28455	
900,417	16-27102	
900,423	16-26946	
900,428	16-27384	
900,452	16-27113	
900,500	16-27173	
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900,698	16-27575	
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901,037	16-27103	
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901,137	16-27176	
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901,240	16-28315	
901,324	16-27577	
901,325	16-27578	
901,330	16-28458	
901,459	15-27388	
901,502	15-27513	
901,508	15-28459	
901,634	15-28460	
902,215	16-27389	
902,301	16-27540	
902,302	16-27541	
902,303	16-27542	
902,304	16-27543	
902,310	16-28461	
902,376	16-28462	
902,377	16-27151	
902,478	16-26947	
902,647	16-27390	
902,679	16-27177	
902,684	16-27391	
902,732	16-26948	
902,741	16-27152	
902,755	16-27544	

Report No.	Abstract No.	Availability
902,786	16-28463	
902,797	16-28464	
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902,889	16-28466	
903,055	16-27178	
903,080	16-28467	
903,142	16-28590	
903,154	16-28591	
903,180	16-27529	
903,201	16-27616	
903,227	16-28468	
903,260	16-27617	
903,265	16-27392	
903,288	16-28469	
903,289	16-28470	
903,303	16-28471	
903,443	16-27247	
903,450	16-27618	
903,480	16-28472	
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903,580	16-28474	
903,584	16-27688	
903,640	16-27179	
903,713	16-27530	
903,715	16-27620	
PATENTS	**(French)**	
1,230,021	16-28475	
1,230,084	16-27393	
1,230,547	16-27180	
1,230,671	16-28476	
1,232,835	16-27394	
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1,244,959	16-28484	
1,245,733	16-28485	
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1,246,230	16-27514	
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1,247,095	16-28492	
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1,248,467	16-27689	
1,248,539	16-28494	
1,250,669	16-28495	
1,251,465	16-28496	
1,253,820	16-28497	
1,257,527	16-28498	
1,258,214	16-28499	
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1,260,628	16-28503	
1,261,104	16-28504	
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1,265,485	16-28506	
1,274,093	16-28490	
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,042,594	16-27621	
3,043,653	16-27114	
3,043,656	16-27579	
3,043,727	16-27580	
3,043,759	16-27531	
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3,045,528	16-27399	
3,046,087	16-27153	
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3,046,089	16-27117	
3,046,090	16-27583	
3,046,109	16-27691	
3,046,207	16-27106	
3,046,208	16-27107	
3,046,210	16-27532	
3,046,212	16-28511	
3,046,223	16-27723	
3,046,396	16-26950	
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3,046,650	16-27584	
3,047,359	16-27118	
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3,047,479	16-28512	
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3,047,485	16-28514	
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3,047,501	16-27030	
3,047,717	16-27401	
3,047,720	16-27402	
3,047,721	16-27403	
3,047,760	16-27404	
3,047,761	16-27405	
3,048,531	16-27108	
3,048,643	16-27856	
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3,048,701	16-27187	
3,048,730	16-27406	
3,048,772	16-26951	
3,048,773	16-27407	
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3,049,497	16-26889	
3,049,619	16-27408	
3,049,620	16-27409	
3,049,621	16-27410	
3,049,661	16-27411	
3,049,662	16-27412	
PATENTS	**(U.S.S.R.)**	
141,560	16-27746	See FTD-TT-62-12

Report No.	Abstract No.	Subject Category and Classification
PST-Cat.–	(Misc.)	
802*	16-27131	See OTS-61-31210
PUC–		
1962-71	16-28034	Dep.(mc); $9.10(fs), $3.44(mf) OTS
Q–		
A-2392-3-4	16-27162	See TID-16105
R–	(Misc.)	
452.21-62*	16-28255	See NP-11787
8107	16-28429	For translation see EURAEC-286
625D35*	16-28621	
RAI–		
307	16-27036	Dep.(mc); $2.60(fs), $1.07(mf) OTS
RME–		
130	16-27310	Nucleonics 19: No. 9, 90-92(1961)
RRL–	(Misc.)	
55	16-27079	J. Phys. Chem. 65: 703(1961)
RT-B–	(Italian)	
10(62)6	16-26777	Boll. zool., 28: 247-52(1961)
RT-EL–	(Italian)	
62(12)	16-27280	Comit. nazl. energia nucleare, Notiz. 8: No. 3, 2-16(1962)
RT-FI–	(Italian)	
(62)3	16-28013	See NP-11733
(62)8	16-28268	Electrotecnica, 48: 1-7(1961)
(62)19	16-27279	Comit. nazl. energia nucleare, Notiz. 8: No. 2, 3-9(1962)
RT-ING–	(Italian)	
(62)3	16-28609	Comit. nazl. energia nucleare, Notiz, 8: No. 3, 3-11(1962)
(62)5	16-27278	Comit. nazl. energia nucleare, Notiz. 8: No. 1, 3-8(1962)
SB–	(Non-AEC)	
62-18	16-28620	See NP-11924
SCDC–		
2636	16-27266	See UNM-TR-EE-66
SCL-T–		
421	16-27272	Dep.(mc); $1.10(fs), $0.80(mf) JCL
429	16-27046	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
SCNC–	(Misc.)	
305*	16-27606	
SCR–		
464	16-27170	p.103-28 of "Symposium-Electronic Systems Reliability, Kansas City, Missouri, November 14, 1961."
495	16-26973	Appl. Spectroscopy, 16: 24(1962)
499	16-27549	Dep.; $0.75(OTS)
SRO–		
68	16-28542	Dep.(mc); $1.60(fs), $0.80(mf)
69	16-28543	Dep.(mc); $1.60(fs), $0.80(mf) OTS
STI-PUB–	(International Atomic Energy Agency)	
34(Vol.I(p.25-39)	16-27039	See AEC-tr-5152
43	16-27511	$1.00(IAEA)
TDS–	(Canadian)	
4A	16-28009	Pt. I of AECL-1504
4B	16-28009	Pt. II of AECL-1504
TEI–		
809	16-27419	Dep.(mc); $11.50(fs), $4.88(mf) OTS
TID–		
3712	16-26647	Dep.; Free(DTIE)
7623	16-28544	Dep.; $3.00(OTS)
7631	16-28383	Dep.; $5.00(OTS)
7636	16-28176	Dep.; $4.00(GPO)
15330	16-26736	Dep.(mc); $10.10(fs), $3.95(mf) OTS
15332	16-28035	Dep.(mc); $4.60(fs), $1.43(mf) OTS
15969	16-27193	Dep.(mc); $1.60(fs), $0.80(mf) OTS
15972	16-26684	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16015	16-27420	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16019	16-27562	Dep.(mc); $1.60(fs); ,$0.80(mf) OTS
16026	16-26737	$1.60(fs), $0.80(mf) OTS
16059	16-28036	$9.60(fs), $3.68(mf) OTS
16083	16-28231	Dep.(mc); $6.60(fs), $2.03(mf) OTS
16105	16-27162	Dep.(mc); $3.60(fs), $1.25(mf) OTS
16111	16-27563	Dep.(mc); $3.60(fs), $1.40(mf) OTS
16124	16-27037	Dep.(mc); $8.10(fs), $2.72(mf) OTS
16217	16-27194	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16220	16-28413	$1.10(fs), $0.80(mf) OTS
16226	16-27195	Dep.(mc); $1.60(fs), $0.80(mf) OTS
16238	16-27550	Dep.(mc); $4.60(fs), $1.67(mf) OTS
16289	16-27196	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16290	16-26876	Dep.(mc); $8.60(fs), $2.96(mf) OTS
16321	16-28414	Dep.(mc); $4.60(fs), $1.43(mf) OTS
16326	16-27263	Dep.(mc); $6.60(fs), $2.03(mf) OTS
16328	16-26738	Dep.(mc); $2.60(fs), $1.04(mf) OTS
16348	16-27421	Dep.(mc); $9.60(fs), $3.62(mf) OTS
16358	16-27163	Dep.(mc); $2.60(fs), $1.10(mf) OTS
16370	16-27422	Dep.(mc); $4.60(fs), $1.52(mf) OTS
16373	16-27695	Dep.(mc); $4.60(fs), $1.70(mf) OTS
16376	16-26739	Dep.(mc); $1.10(fs), $0.80(mf) OTS
16379	16-27564	Dep.(mc); $1.60(fs), $0.85(mf) OTS
16380	16-26685	$2.60(fs), $1.40(mf) OTS
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